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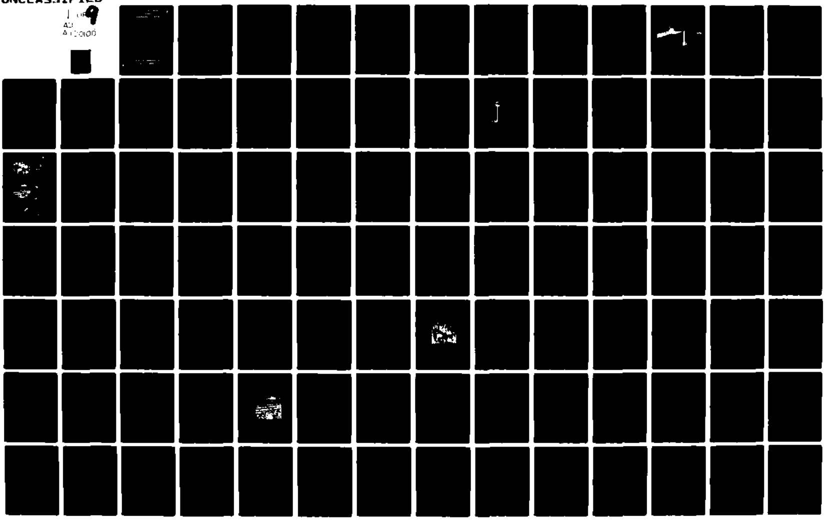

COOPER LAKE AND CHANNELS, TEXAS

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*
Final environmental impact statement (EIS) for the Cooper Lake and Channels project was filed with the Council on Environmental Quality on 24 June 1977. Supplemental EIS on Cooper Lake and Channels, Texas dated March 1981 is a reevaluation of that EIS taking into consideration a no action alternative; along with four (4) alternative solutions to these problems identified as flooding, water supply, recreation problems and recreational needs in the Sulphur River Basin. This report reevaluates two plans previously considered for comparison. These new plans are presented to respond to these deficiencies by showing full benefit/cost analysis,

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and recommending fish and wildlife mitigation plans. Reservoir Only plan was selected as the best overall plan for meeting the project purposes.

FINAL

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
TO THE

FINAL ENVIRONMENTAL STATEMENT
FOR
COOPER LAKE AND CHANNELS, TEXAS

FILED 24 JUNE 1977

The responsible lead agency is the US Army Engineer District, Fort Worth

ABSTRACT: This supplemental EIS evaluates the no action alternative and four alternative solutions to identified flooding, water supply, and recreation problems and needs in the Sulphur River Basin, Texas, and recommends a plan to partially resolve these identified problems and needs. The supplemental EIS reevaluates two plans previously considered in a final EIS filed 24 June 1977 (Reservoir and Levees and Reservoir Only) and presents a new Water Supply Only plan and Comprehensive Non-structural plan for comparison. These new plans are presented to respond to noted deficiencies of the final EIS as instructed in a Memorandum Opinion enjoining construction of the project filed by the US District Court for the Eastern District of Texas on 8 December 1978. The supplemental EIS also responds to other deficiencies noted in the Memorandum Opinion by publishing State agency comments and response deleted from the final EIS, displaying full benefit/cost analysis, and recommending fish and wildlife mitigation plans. Of the four alternatives evaluated, the Reservoir Only plan was selected for recommendation as the best overall plan for meeting project purposes. Provisions to mitigate net adverse impacts on the environment, including recommendations to seek authorization for purchase of wildlife mitigation lands, are included in the recommended plan.

If you would like further information on this supplement, please contact:

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LIST OF PREPARERS

As evidence of the interdisciplinary planning approach required by Section 102(2)(A) of the National Environmental Policy Act of 1969, the names and disciplines of the principal preparers and contributors of the Supplemental Environmental Impact Statement are presented here.

NAME	EXPERTISE/DISCIPLINE	EXPERIENCE	ROLE IN PREPARING
Michael J. Mocek	Civil Engineer/Water Resource Planning	9 years, water resource planning	Study Manager/Alternatives Formulation
James E. Warren	Regional Economist	3 years in design, 18 years in water resource planning and evaluation	Economic and Social Analysis
William L. Harrell	Environmental Planner	3 years at water resource operating project, 6 years ecologist, planning, EIS studies	EIS Coordinator/wildlife Studies
Paul M. Hathorn	Environmental Specialist	2 years at water resource operating project, 3 years in planning, EIS, and aquatic/water quality studies	Fisheries
Samuel E. Garrett, Jr.	Landscape Architect	12 years, environmental and recreation resource planning for water resources	Recreation Analysis
George Prochaska	Civil Engineer/Water Resource Planning	2 years, water resource planning	Non-structural Studies
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Jack Thompson	Regional Economist	10 years, water resource planning	Economic and Social Analysis

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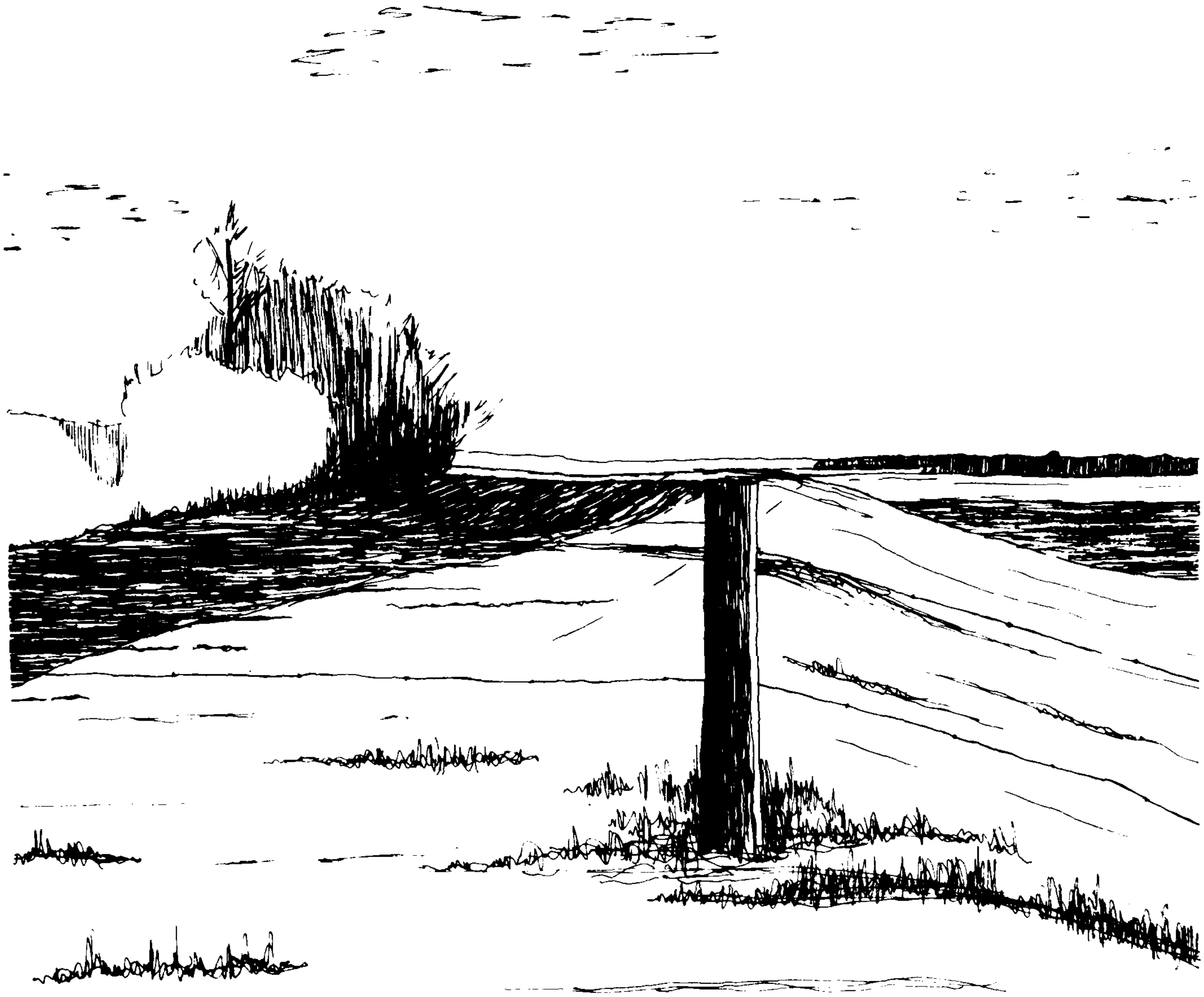


SECTION I - SUMMARY

SECTION I - SUMMARY

CONCLUSIONS AND FINDINGS

1.01 Purpose. A final environmental impact statement (EIS) for the Cooper Lake and Channels project was filed with the Council on Environmental Quality on 24 June 1977. This final EIS evaluated 22 alternatives and the no action or without project condition which would meet or partially meet purposes of the project authorized by Congress. These purposes are flood control, water supply, and recreation. Completion of the project had been enjoined in 1971 by the US District Court of the Eastern District of Texas pending completion of a final EIS, though planning, land acquisition, and other nonconstruction activities were allowed to continue. The final EIS recommended a Reservoir and Levee plan be constructed, pending resolution of the injunction, as the best overall plan in the public interest of the 22 alternatives considered. This plan consisted of a multiple-purpose reservoir, Cooper Lake, on the South Sulphur River, about 27 miles of remaining downstream levee improvements, and 6.6 miles of new channels bypassing river segments cut off by the levee alignments. This plan reduced the river affected by about 62 miles as compared to the authorized plan, while retaining almost all of the benefits.

On 8 December 1978, the court issued a Memorandum Opinion detailing five inadequacies of the final EIS and permanently enjoined further construction of the project pending correction of the noted inadequacies. These inadequacies are the subject of this final supplemental EIS. In responding to the inadequacies listed in the Memorandum Opinion, a water supply only alternative and a comprehensive nonstructural flood plain management plan have been formulated for comparison against the Reservoir and Levee plan recommended in the final EIS. In addition, various modifications to the recommended final EIS plan have been evaluated to further reduce environmental impacts, including deletion or modification of some or all of the remaining downstream levees and channels. The Reservoir Only plan considered in the draft and final EIS has also been reevaluated in this final supplemental EIS. Changes in the basin setting and National environmental policy and legislation occurring between 1974 and the present have been considered in evaluating these alternative plans and selecting the best alternative for recommendation. Alternatives were evaluated under 1974 land use conditions, price levels, and benefits, in order to maintain general comparability with previous alternatives considered in the final EIS. The plan selected in this final supplemental EIS is also presented at 1980 price and benefit levels and considers 1980 land use conditions and trends.

This final supplemental EIS also presents information determined by the court to be missing from the final EIS. State agency comments on the draft EIS received informally by the Corps but not published in the final EIS are now published herein with appropriate Corps response. This completes section IX of the final EIS filed 24 June 1977. Fish and wildlife mitigation needs for the alternatives and recommended mitigation plans for the selected alternative are evaluated and made a part of the supplemental EIS which completes joint actions required

under the Fish and Wildlife Coordination Act and the National Environmental Policy Act. Full information on benefit/cost analysis used in evaluating alternative plans but not included in the final EIS is also presented in the supplemental EIS.

1.02 Alternatives Evaluated in the Supplemental EIS (1974 Price Levels)

a. Reservoir and Levees. This is the plan recommended in the final EIS. It consists of a multiple-purpose dam and reservoir at river mile 23.2 of the South Sulphur River, with a 19,305 surface acre water supply pool, 30-year flood storage capacity, and recreation development. About 27 miles of new or improved downstream levees and 6.6 miles of new channels would be constructed This alternative would provide 30-year protection to about 24,300 acres of flood plain lands, 109 mgd dependable water supply yield, 933,200 recreation days, and enhancement of agricultural production on protected lands. This plan will result in the loss or degradation of about 35,000 acres of terrestrial wildlife habitat, including at least 8,300 acres of overflow riverine wetlands, and 27 miles of river aquatic habitat. Mitigation for identified adverse impacts on terrestrial habitat would require the acquisition and management of about 48,600 acres of mitigation lands. This plan has a first cost of $84.6 million, including mitigation. Average annual charges total $3.69 million, and average annual benefits for flood control, water supply, recreation, fish and wildlife, and redevelopment total $5.64 million. The benefit-to-cost ratio is 1.53, and there are $1.94 million in net excess benefits.

b. Reservoir Only. This is the plan now selected for recommendation in the supplemental EIS. It consists of constructing the multiple-purpose reservoir feature of the Reservoir and Levees plan, with no additional downstream levees or channels (with the exception of Spur 4RSS required in conjunction with the outlet channel for the dam). This alternative would provide the same water supply and recreation benefits of the Reservoir and Levees plan but would reduce flood protected downstream lands to about 12,900 acres of mostly developed agricultural land. This plan would result in the loss or degradation of about 25,400 acres of terrestrial wildlife habitat, including at least 2,100 acres of wetlands and 21 miles of river aquatic habitat. Mitigation for identified adverse impacts on terrestrial habitat would require acquisition and management of about 25,500 acres of mitigation lands. This plan has a first cost of $67.1 million, including mitigation. Average annual charges total $3.00 million, and average annual benefits for flood control, water supply, recreation, fish and wildlife, and redevelopment total $5.04 million. The benefit-to-cost ratio is 1.68, and there are $2.04 million in net excess benefits.

c. Water Supply Only. The most likely water supply only project which would be constructed by local sponsors in the absence of a Federal project is at Cooper Lake at the same damsite with the same size water supply pool. It is unlikely that the local sponsors would acquire more land than that necessary for the project, which would total about 22,075 acres, or about 8,000 acres less than for the Federal multiple-purpose project. It is expected, however, that minimum facilities for

recreation would be constructed by the local sponsors or local governments on acquired lands, and public water access would be provided. This alternative would provide the 109 mgd dependable water supply yield and is expected to provide about 275,000 recreation days. This plan would result in the loss or degradation of about 21,400 acres of terrestrial habitat, including at least 80 acres of wetlands and 21 miles of river aquatic habitat. Mitigation, if accomplished by the local sponsors, would require acquisition and management of about 25,500 acres of mitigation lands. It is unlikely that full mitigation would be implemented by non-Federal interests, however. This plan has a first cost of $61.6 million, and average annual benefits for water supply, recreation, and fish and wildlife total $3.15 million. The benefit-to-cost ratio is 1.28, and net excess benefits are $683,400.

d. Comprehensive Nonstructural. This plan is a largely voluntary land use flood plain zoning plan which would be implemented by private landowners based on expected flood frequency, soil types, erosion hazards, and expected damages to various crops or land uses. About 66,200 acres of land within the 3-year flood plain would be used for wildlife habitat, and this land would improve in natural values. Timber management and conversion of pastureland to hay crops on lands within the 3- to 30-year flood plain would reduce damages. Abandonment of fencing in high flood hazard areas, flood proofing of two houses, technical assistance, and zoning of the flood plain against future construction of damageable property are also aspects of the flood plain management plan. Recreation added to this voluntary plan is incrementally justified but would require local sponsorship to acquire about 24,200 acres of corridor lands within the 3-year flood plain and develop about nine access parks. This alternative has the potential for reducing flood damages by about $183,100, and with recreation added, would provide about 542,000 recreation days and fish and wildlife gains, for a benefit of $826,700. The plan has a first cost of $10.1 million and a benefit-to-cost ratio of 1.60. Net benefits are $379,200. This is the most environmentally preferable plan but has no provisions for the water supply purpose. It could be implemented in conjunction with the Water Supply Only alternative to fulfill all project purposes.

e. No Action Alternative. The without project or existing (status quo) condition of the Sulphur River flood plain is considered to be the time of the 1971 court injunction. The no action alternative is the projection of the future without project conditions from this base condition over the project life. In the absence of any further work by the Corps of Engineers under the Cooper Lake and Channels authorization, it is projected that most existing levees in the Sulphur River flood plain will gradually become more ineffective over time. This is not expected to significantly change overall land use. Open and semiwooded land will remain in these land uses, though they may experience more frequent flooding, and clearing on a major scale is not expected. The majority of land in the 91,200 acre 30-year flood plain will remain subject to frequent flooding and will not be developed for pasture or cropland. Local interests, at some future date, may develop the surface water supply yield of the Sulphur River in the absence of a Federal multiple-purpose project.

1.03 Selected Plan. Based on analysis of 1974 price levels and land use conditions, statements received at the public meeting in Sulphur Springs, Texas, on 24 November 1980, and comments received on the draft supplemental EIS, the Reservoir Only plan provides the most economically efficient plan to accomplish authorized purposes, including analysis of terrestrial habitat mitigation for adverse impacts, of any plan evaluated in this supplemental EIS. Based on this efficiency, plus wetlands considerations, reduction in adverse environmental impacts, and other social-economic considerations, the Reservoir Only plan is selected for recommendation. Net adverse impacts on two terrestrial habitats as a result of implementation of this plan would require the acquisition and mid-level development and management of 29,783 acres of in-kind habitats according to studies completed by the USFWS. For the Reservoir Only plan, the USFWS, by Planning Aid Letter dated August 19, 1980, subsequently recommended a tract of land upstream of Wright Patman Lake which would fully compensate for net adverse terrestrial losses. Due to dissimilar habitat types which do not match in kind the identified habitat losses, and the need to block out a manageable wildlife unit, the area recommended included 33,400 acres.

As part of the Reservoir Only plan, the Corps recommends full compensation of bottomland hardwood losses by land acquisition, development and management of about 25,500 acres in the recommended area, additional development, and management of project lands acquired for Cooper Lake, and conversion of 751 acres of flowage easement downstream of Cooper dam to fee ownership. This plan will almost fully compensate for terrestrial losses. The USFWS subsequently concurred in their Coordination Act report that the terrestrial mitigation plan was acceptable.

The USFWS also recommended continuous downstream releases to optimize the remaining stream fishery downstream from Cooper dam. The Corps cannot comply with this recommendation but does recommend that the requested releases be made from holding 5 percent of the flood storage in the lake, when available, and making releases at the requested rate until the lake elevation returns to normal conservation pool. A 5 cfs continuous low flow release is also recommended.

The selected plan is in consonance with all environmental laws, national policies, and regulations. The relationship of the selected plan to these laws, policies, and regulations is detailed in paragraphs 1.07 through 1.16 of this summary.

At the public meeting held in Sulphur Springs, Texas, 24 November 1980, the Texas Department of Water Resources (TDWR) expressed opposition to the acquisition of mitigation land as a shared project cost to the water supply sponsors. The North Texas Municipal Water District (NTMWD) also expressed the cost of mitigation to the water supply sponsors as unfair, but also expressed the need to complete the project and supported the plan. The majority of commentors on the draft supplemental EIS supported the wildlife mitigation plan.

AREAS OF CONTROVERSY

1.04 Wildlife Habitat Mitigation. The issue of mitigation for impacts to wildlife habitat caused by the project has been a

continuing area of controversy. The lack of concurrent mitigation planning with project construction and NEPA is a noted deficiency of the final EIS. Mitigation requirements for each alternative are considered in the supplemental EIS developed through coordination with the USFWS and Texas Parks and Wildlife Department (TPWD) under the Coordination Act. A recommended mitigation plan for the selected alternative is presented. Mitigation by land acquisition is not presently authorized by Congress, and the recommended mitigation plan will require authorization and funding by Congress before it can be implemented. As the mitigation plan will increase the cost of water supply in the project to the local sponsors and the initial cost to the taxpayer and will require additional land acquisition, this issue is expected to remain controversial.

1.05 Water Supply Needs. There are three local sponsors for the water supply storage in Cooper Lake, each having signed contractual agreements with the Secretary of the Army. Water supply studies are independently conducted by the Corps of Engineers to determine the identified net need for existing or future water supply storage in the service area affected by an authorized Federal multiple-purpose project. These need studies are conducted under Federal Water Resource Council criteria and determine the projected need for water, both under existing usage and projections and with assumed conservation measures in place to reduce future demand. The art of projecting water supply needs is controversial, both with local sponsors and environmental and conservation groups, since a number of assumptions and predictions on growth and water usage must be made.

Water supply needs studies conducted by the Corps show a net immediate need for some Cooper Lake water before the year 1990 and a future need by the year 2010. Most of this projected need is by the NTMWD service area, and Corps studies indicate the other project sponsors have adequate supplies until the year 2010. Projections made by NTMWD and the other two local water supply sponsors indicate a greater and more immediate net need for water than the Corps studies. The NTMWD position on water supply needs is expressed in exhibit 1 to appendix D. During coordination of the draft supplemental EIS, the Sierra Club and Texas Committee on Natural Resources provided comments questioning water supply needs projections. These comments have been addressed in this supplement, and the water supply needs study is now included as exhibit 2 to appendix D.

UNRESOLVED ISSUES

1.06 Mitigation. The Corps recommends additional mitigation lands be acquired and managed to compensate for fish and wildlife habitat losses caused by the Cooper Lake project. As mitigation by land acquisition is not authorized by Congress, the implementation of the recommended mitigation plan is not finalized. This will require processing a Mitigation Report through postauthorization change procedures for presentation to Congress. This may require further interagency review, and the process will be initiated after a decision is made after review of the final supplemental EIS. The Corps was unable to comply with the USFWS requests for continuous streamflows above 5 cfs and stage filling. The majority of adverse comments received on the draft supplemental EIS related to the instream flow/aquatic mitigation issue.

RELATIONSHIP TO PUBLIC LAWS, EXECUTIVE ORDERS, AND RELATED POLICIES PERTAINING TO ENVIRONMENTAL QUALITY

1.07 National Environmental Policy Act of 1969 (PL 91-190), Executive Order 11514, Executive Order 11991, and Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act, 29 November 1978. This supplemental EIS, in conjunction with the draft EIS filed 1 June 1976 and the final EIS filed 24 June 1977, fulfills the requirements of Section 102(2)(c) of PL 91-190 for preparation of a detailed statement on major Federal actions significantly affecting the quality of the human environment and the mandate of EO 11514, 5 March 1970, that all Federal agencies direct their policies, plans, and programs to protect and enhance environmental quality. Information in the final EIS and supplemental information provided in the supplemental EIS to correct deficiencies noted in the Memorandum Opinion of 8 December 1978 are intended to fully disclose the environmental impacts of the selected plan and alternatives and provide for consideration of adverse impacts so they may be avoided, minimized, or compensated for in the decision making process. Background information and supporting documentation have been included in appendices to the supplemental EIS so that environmental issues and relationships between alternatives can be expressed in a concise report as envisioned by the CEQ regulations and mandated by EO 11991.

1.08 Fish and Wildlife Coordination Act of 1958 (PL 85-624), as Amended. Coordination with the USFWS and the Texas Parks and Wildlife Department on the Cooper Lake and Channels project has resulted in a Coordination Act report dated July 13, 1966, a letter report dated March 8, 1972, in response to a request by the Corps in regard to the preparation of the draft EIS, a letter report dated September 3, 1976, addressing the need for additional mitigation measures, and a current Coordination Act report documenting ongoing coordinating efforts to develop an appropriate mitigation plan for fish and wildlife impact to respond to the Memorandum Opinion. Documentation of compliance with the Fish and Wildlife Coordination Act is presented in appendix B. The mitigation plan presented in this supplemental EIS was developed through coordination with the USFWS and the Texas Parks and Wildlife Department.

1.09 Section 7, Endangered Species Act of 1973 (PL 93-205), as Amended. None of the alternatives considered will have a significant effect on migrating or wandering bald eagles or peregrine falcons, listed species known to occur within the Sulphur River Basin. The only other listed species of endangered or threatened wildlife which may occur within the Sulphur River Basin are the American alligator and the red-cockaded woodpecker. No populations of these species are known within the area affected by alternatives, although alligators have been restocked below Wright Patman dam. No significant project effects on American alligators, as reported in the final EIS, are expected. Due to insignificant identified impacts on listed species, no Section 7 consultation has been initiated.

1.10 Preservation of Historical and Archeological Data (PL 93-291), Historic Preservation Act of 1966 (PL 89-655) and Executive Order 11593. Reconnaissance, survey, and testing investigations in the Cooper Lake

and downstream areas were undertaken in 1970-72, 1973, and 1974-75. Based on these investigations, the Cooper Lake Archeological District was determined eligible to the National Register in 1977. This district encompasses most of the project lands at Cooper Lake. On 24 February 1978, the State Historic Preservation Officer concurred with the Corps' determination of no adverse effect on the district as a result of construction of Cooper Lake, due to mitigation being accomplished by the past survey and testing work completed there. The Advisory Council on Historic Preservation was provided the opportunity to comment, and on 31 May 1978, provided a letter of no comment on the undertaking. To complete the mitigation agreement reached with the State Historic Preservation Officer, the Corps will publish a popular summary of the cultural resources at Cooper Lake upon resumption of construction.

1.11 Wild and Scenic Rivers Act, PL 90-542, as Amended. The Sulphur River is not designated nor under study for the National Wild and Scenic Rivers System. The State of Texas in Texas Waterways: A Feasibility Report on a System of Wild, Scenic, and Recreational Waterways in Texas, Texas Parks and Wildlife Department, 1973, does not list the Sulphur River as having potential for a State wild, scenic, or recreational river.

1.12 Coastal Zone Management Act of 1972, PL 92-583, as Amended. Not applicable.

1.13 Executive Order 11990 - Protection of Wetlands. Wetlands have been declared an important natural resource warranting specific measures for protection by the President in EO 11990 issued 27 May 1977. Both the Chief of Engineers and the Administrator of the Environmental Protection Agency (EPA) have developed similar guidelines and policies concerning wetlands applicable to water resource development projects. Section 2(a) of EO 11990 states in part as follows:

> ". . . each agency, to the extent permitted by law, shall avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds (1) that there is no practicable alternative to such construction, and (2) that the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use."

Section 5 cites factors to be considered by agencies in carrying out the activities required by the EO. These are described as follows:

> "In carrying out the activities described in Section 1 of this Order, each agency shall consider factors relevant to a proposal's effect on the survival and quality of the wetlands. Among these are:
>
> a. public health, safety, and welfare, including water supply, quality, recharge and discharge; pollution; flood and storm hazards; and sediment and erosion;
>
> b. maintenance of natural systems, including conservation and long term productivity of existing flora and fauna, species and habitat diversity and stability, hydrologic utility, fish, wildlife, timber, and food and fiber resources; and

c. other uses of wetlands in the public interest, including recreational, scientific, and cultural uses."

The remaining unleveed wooded flood plain of the Sulphur and South Sulphur River below the Cooper damsite contains significant areas identified as wetlands. The majority of the wooded area is considered a palustrine, seasonally flooded, broad leafed deciduous forested wetland. Lacustrine aquatic bed wetlands, palustrine emergent wetlands, and palustrine broad leafed deciduous scrub-shrub wetlands are also found in the flood plain in and around permanently flooded, temporarily flooded, or seasonally flooded oxbow lakes and sloughs.

The primary value of these wetlands is habitat for game and nongame wildlife, primarily deer, squirrel, woodpeckers, waterfowl, and furbearers. These wetlands also function as fisheries habitat and spawning areas where the water is relatively permanent and for water quality maintenance, floodwater and sediment storage, timber production, recreation, and other values largely unquantified.

The Reservoir Only alternative now selected for recommendation reduces the indirect impacts on wetlands through intensification by about 5,600 acres over that caused by the Reservoir and Levees plan formerly recommended in the final EIS. In addition, the quality of wetlands indirectly impacted by the Reservoir Only plan is much less than those impacted by the downstream levees and channel feature of the Reservoir and Levees plan now deleted from recommendation. The recommended Reservoir Only plan will still cause the indirect loss of about 2,048 acres of wetlands through induced clearing, but this is incidental to the protection and enhancement of 12,900 acres of primarily developed agricultural land with flood control storage in the reservoir. The proposed mitigation plan will mitigate fully for the unavoidable direct and indirect loss of wetland values associated with the Reservoir Only plan.

1.14 <u>Executive Order 11988 - Floodplain Management</u>. The EO has as an objective the avoidance, to the extent possible, of long- and short-term adverse impacts associated with the occupancy and modification of the base flood plain and the avoidance of direct and indirect support of development in the base flood plain wherever there is a practicable alternative. Under the Order, the Corps is required to provide leadership and take action to:

a. Avoid development in the base flood plain unless it is the only practicable alternative;

b. Reduce the hazard and risk associated with floods;

c. Minimize the impact of floods on human safety, health, and welfare; and

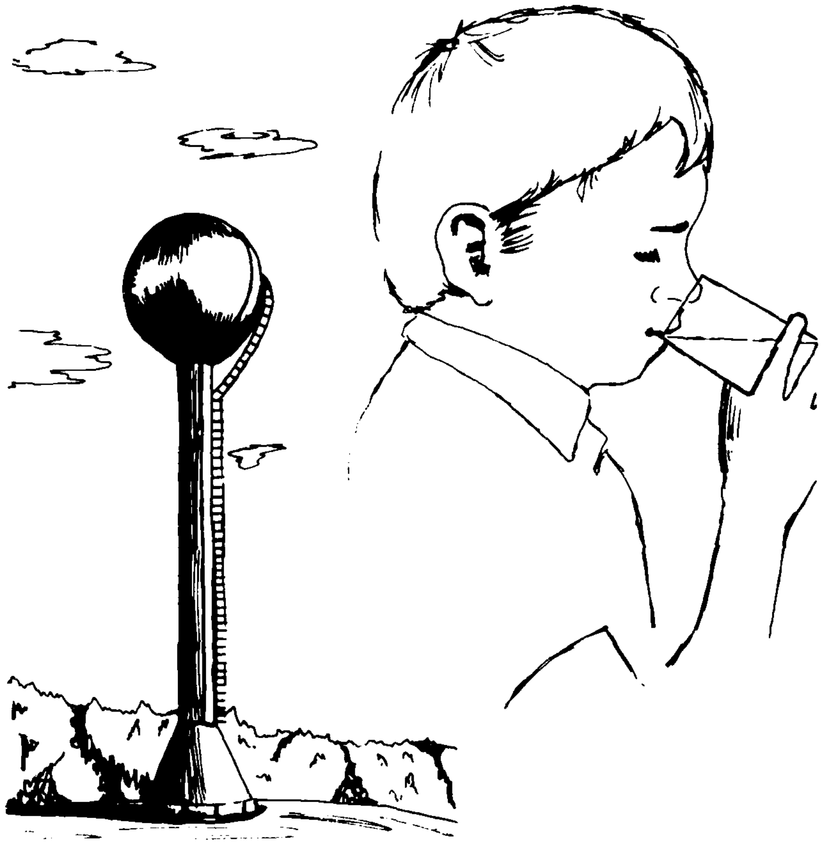
d. Restore and preserve the natural and beneficial values of the base flood plain.

Implementation of the recommended Reservoir Only plan will occur mostly within the base flood plain of the South Sulphur River and must do so to achieve project purposes of water supply, flood control, and water oriented recreation. Practicable alternatives to meeting these purposes outside of the base flood plain are not available. The Reservoir Only plan will reduce the hazard and risk associated with flooding on 12,900 acres of land within the 30-year downstream flood plain and will minimize the impact of floods on human safety, health, and welfare on these lands. It will do so, however, with the expected direct loss of 19,305 acres of flood plain and associated uplands through inundation for water supply and recreation purposes and periodic inundation of 3,435 acres in the flood pool. Beneficial flood plain values associated with agricultural use will be enhanced on the 12,900 acres protected, but natural flood plain values will be lost or degraded on 2,560 acres of wooded lands intensified and about 5,905 acres of wooded land inundated. Beneficial agricultural flood plain values on 13,400 acres of land will also be lost through inundation for the multiple project purposes.

1.15 Section 404 of the Clean Water Act. A public notice announcing the intent of the Corps of Engineers to dispose of dredged and fill material at specified disposal sites in conjunction with the plan recommended in the final EIS (Reservoir and Levees) was issued on 24 February 1978. Ten letters were received in response to the public notice, including certification by the Texas Department of Water Resources. In view of the unfavorable ruling on the adequacy of the final EIS filed for the Cooper Lake and Channels project, and in accordance with statements made in the public notice, the Section 404 aspects of the project have been reevaluated. The disposal plan for construction features of the reservoir presented in the public notice accurately reflects the proposed disposal plan for the Reservoir Only alternative now recommended in the final supplemental EIS. The disposal plan for the downstream levees and channels construction is no longer proposed with deletion of these features from the recommended project. Comments received relating to mitigation and other issues not resolved at the time of the public notice are responded to in the supplemental EIS. The Section 404 evaluation and coordination record is presented in appendix E to the supplemental EIS for the recommended plan. Comments on the proposed disposal plan have been reconsidered in making findings, determinations, and recommendations in the final supplemental EIS and will be considered in the record of decision on the recommended plan, though technical aspects of Section 404 compliance have been previously met with the exception of finalizing a statement of findings. The discharge associated with Cooper dam is determined to be in compliance with Section 404.

1.16 Prime and Unique Farmlands, CEQ Memorandum, 11 August 1980. The recommended Reservoir Only plan will cause the irreversible loss of about 13,400 acres of existing agricultural land due to inundation. Flood control storage in the reservoir feature will enhance production on about 12,900 acres of agricultural lands downstream. Lands acquired for the lake but not permanently flooded and lands acquired for mitigation purposes will be removed from potential private agricultural use but will not be irreversibly committed to project purposes should future National

priorities change. Most flood plain lands in the Sulphur River basin are or have the potential to be prime farmland with control of the flood hazard, based on soil type and land capability classification.



SECTION II - NEED FOR AND OBJECTIVES OF ACTION

SECTION II - NEED FOR AND OBJECTIVES OF ACTION

PROBLEMS, NEEDS, AND OPPORTUNITIES

2.01 Flooding. The Sulphur River and tributary flood plains are subject to frequent floods which may occur at any season of the year. Portions of the South Sulphur, North Sulphur, Middle Sulphur, and Sulphur Rivers, and Brushy and Cuthand Creeks have been channelized and leveed to provide partial protection to agricultural flood plain areas since the early 1900's. The degree of protection provided ranges from 3-year frequency to the Standard Project Flood with various levees. Many existing levees have been broken and not repaired. Under the status quo (1974) condition for the flood plain study area under consideration in this report, about 91,200 acres are subject to flooding by a 30-year frequency event. This includes about 31,200 acres of land used primarily for pasture, and 58,000 acres of wooded land. There are 2 houses subject to flooding with the 30-year frequency flood, and fences, levees, highways, bridges, farm structures, and equipment are also subject to damage. Average annual damages to agricultural and non-agricultural property for this area amount to $2,230,000.

2.02 Water Supply Needs. Municipal and industrial water requirements for five water supplying entities considered to be potential users of water from the general area of the authorized Cooper Lake and Channels project were identified by the Corps in present studies.

These entities are the North Texas Municipal Water District and the cities of Irving, Commerce, Cooper and Sulphur Springs. The cities of Commerce, Cooper and Sulphur Springs collectively form the Sulphur River Municipal Water District which was organized to utilize water from the authorized Cooper Lake.

Two sets of projections were made for each entity. First, baseline projections were made with the assumption that no water conservation programs are implemented beyond those currently in effect. Second, projections were made given the implementation of a conservation program which would reduce seasonal water use by 10 percent and require water saving plumbing fixtures for all new construction and replacement plumbing.

Table II-1 shows projections of net water supply needs, i.e., the excess of projected total municipal and industrial water needs over projected supplies for the five water supplying entities in the aggregate. Net needs are shown for both the baseline and the "with conservation" condition. For the baseline projections net water supply needs are projected to be 13.0 mgd in 1990 and reach 142.5 mgd by 2040. With the institution of the conservation programs net needs would range from 7.7 mgd in 1990 to 121.2 mgd in 2040.

TABLE II-1

NET WATER SUPPLY NEEDS FOR THE COOPER LAKE STUDY AREA

(Millions of Gallons Daily)

YEAR	NET NEEDS BASELINE	NET NEEDS WITH CONSERVATION
1985	--	--
1990	13.0	7.7
2000	28.6	20.5
2010	68.8	56.4
2020	89.1	73.6
2030	114.8	95.7
2040	142.6	121.2

SOURCE: Cooper Lake Water Supply Needs Study, Southwestern Division, Corps of Engineers, April 1980.

2.03 Recreation Needs (Including Hunting and Fishing). In recent years, the demand for outdoor recreation opportunities has rapidly increased throughout Texas. Changes in factors such as population, urbanization, leisure time, buying power, and recreational preferences have created a tremendous pressure on public agencies and private entities to provide more outdoor recreation opportunities. Under the provisions of the Land and Water Conservation Fund Act, each state must develop, maintain, and keep up-to-date a statewide comprehensive outdoor recreation plan. In response to the requirement, the Texas Outdoor Recreation Plan (TORP) of 1975 has been prepared and provides the guide for outdoor recreation development in Texas.

The recreation market area for the Cooper Lake and Channels Project includes 18 Texas counties and overlaps TORP planning regions 11, 12, 13, and 14.

Corps of Engineers studies and the TORP indicate that a wide deficit exists between the projected recreational needs in the recreation market area and the output capacities of all existing and proposed recreational outlets. All studies recognize that there is a critical shortage of recreation facilities for all activities in all planning regions overlapping the recreation market area. It is expected that the continued growth in participation in sport fishing activities will necessitate additional lakes, freshwater boat ramps, fishing piers, barges, and marinas. Additionally, there is a need for improved access to existing lakes and streams and for better management of these existing resources.

Indications are that recreation needs will continue to exceed the number of facilities being provided and that additional recreational outlets will be needed to help reduce this deficit. (The cost of Federal facilities required to meet these future needs would be subject to cost sharing by a non-Federal entity under the provisions of PL 89-72.)

Based on comparisons of current and future demands for hunting lands, there will be a need for additional hunting lands in the South Sulphur River basin. A number of special problems exist with regard to providing adequate hunting opportunities in Texas. According to the TORP, the foremost among these problems is the lack of access to private lands suitable for hunting. Other problems are high cost, restrictive leasing practices of private landowners, crowded conditions on public hunting lands, less than optimum distribution of wildlife and lands available for hunting, low harvest rates, and the critical loss of high quality wildlife habitat from competing land uses. The alleviation of these problems would make the most effective contributions toward providing more adequate hunting opportunities for Texas.

According to the TORP, there is also a need to acquire areas that are unique or that have particular value for wilderness preservation. Special attention will be given to preserving the critical bottomland hardwood areas that still exist in a relatively undisturbed state.

Recreation in these areas should revolve around low impact, low density use with emphasis on interpretive programs. Special consideration should be given to acquisition of wilderness areas close to urban centers.

The need for preservation of natural areas for open space and fish and wildlife management is increasingly apparent as more existing areas are encroached upon by commercial or housing developments and more intensified land use.

OBJECTIVES

2.04 Project purposes and objectives. Alternatives developed and analyzed for the Cooper Lake and Channels Project should fulfill the three primary purposes of the authorized project which are flood control, municipal and industrial water supply, and recreation. The water supply purpose is not limited to the Cooper Lake but includes the provision of water supply storage in Wright Patman Lake through the conversion of flood control space at Wright Patman Lake. This conversion can be accomplished only by providing substitute flood control storage space upstream of Wright Patman Lake or by undertaking major structural modifications to Wright Patman dam and lake. This latter prospect is beyond the scope of the authorizing legislation for the Cooper Lake project.

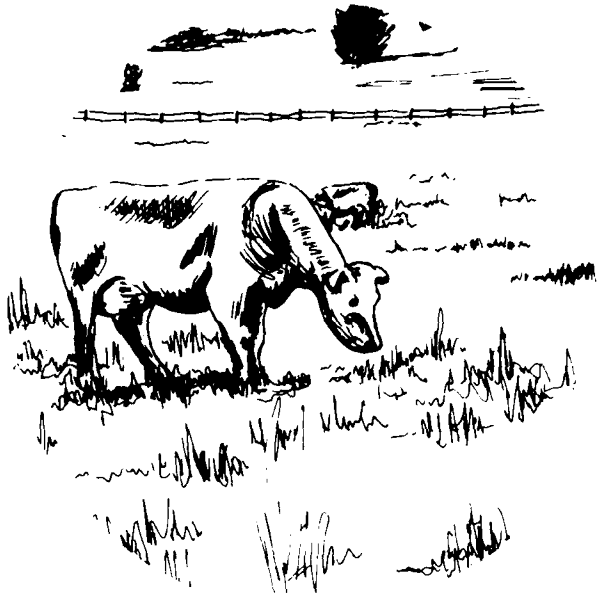
a. Flood control. Flood protective improvements or features should provide direct protection or flood plain management against a basin-wide flood with a 30-year return frequency. Any alternatives proposed which include a reservoir should provide at least enough storage capacity in the reservoir to regulate a 30-year flood to a maximum downstream release of 3,000 cfs. The flood protection afforded should, to the greatest extent practicable, provide a continous level of protection or flood plain management along the Sulphur River and its tributaries upstream of Wright Patman Lake.

b. Municipal and industrial water supply. Alternative means to fulfill this purpose should provide either surface storage space located in the general service area and reserved exclusively for water supply, or should provide a yield of water from any other source which could meet or partially meet identified net needs within the time frame predicted. Only surface storage represents a reasonable means of fulfilling this purpose, and the alternative plans developed which fulfill this purpose all contemplate use of new existing surface sources to meet identified water supply needs.

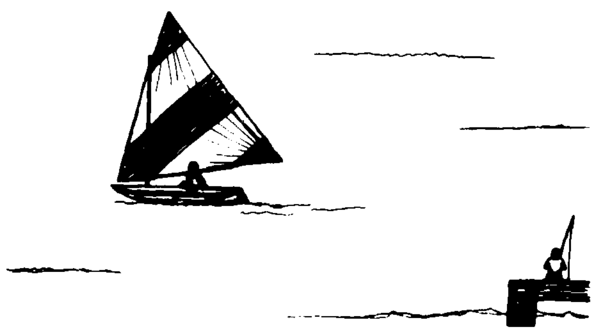
c. Recreation. The type of recreational opportunities contemplated by the authorizing legislation relate to lake or lake-oriented activities. Those activities very generally include fishing, hunting, swimming, boating, camping, biking, sightseeing, nature study, and picnicking. It is recognized that the development of a reservoir in the project area will stimulate a more intensive recreational involvement by adjacent community members. The basic policy for Federal participation in the development of recreation facilities for authorized reservoirs is contained

in PL 89-72, approved 9 July 1965. In accordance with Corps policy implementing PL 89-72, initial recreation facilities may be developed at Federal expense at the authorized Cooper Lake. The extent of the development permitted under Corps policy includes those facilities in "primary areas necessary to provide a balanced plan for public access in the vicinity of project structures and in the water area in accordance with the level of demand anticipated during the first 3 years of operation. In general, each primary area proposed for development during project construction should be developed initially to a level of at least two-thirds of its ultimate potential." Local interests have indicated no firm desire to participate in the development of recreation facilities, so only initial facilities may be provided. Opportunities for Federal recreation participation in alternatives not including a multipurpose reservoir are limited, but in some cases may be included in local protection projects or nonstructural plans recommended by the Corps.

d. Fish and Wildlife. Fish and wildlife per se is not a project purpose in the authorization. The full consideration of fish and wildlife through planning to avoid adverse impacts and mitigation of ecological losses is, however, a planning objective.

SECTION III - ALTERNATIVES



SECTION III - ALTERNATIVES

AUTHORIZATION

3.01 Authorization for Construction. Congressional authorization for the construction of the Cooper Lake and Channels, Texas project is contained in the Act approved 3 August 1955 (Public Law 218, Chapter 501, 84th Congress, 1st Session). The act authorizes the construction of the Cooper reservoir and channel and levee improvement ". . . substantially in accordance with the construction plans recommended in the report of the Chief of Engineers in House Document Numbered 488, Eighty-third Congress, 2nd Session: PROVIDED, That local interests shall contribute toward the costs of construction, maintenance, and operation of Cooper Reservoir the amounts allocated to water supply; and shall, with respect to other features of the modified project, give assurances satisfactory to the Secretary of the Army that they will:

(1) Provide without cost to the United States all lands, easements, and rights-of-way, and make alterations and relocations of highways and related facilities, and utilities except railroads, necessary for the construction;

(2) Hold and save the United States free from damages due to the construction; and

(3) Maintain and operate all works after completion, and preserve channel capacities by preventing encroachment, in accordance with regulations prescribed by the Secretary of the Army."

3.02 Authorization for Advanced Planning. Authority to initiate advanced planning on the Cooper Lake and Channels project is contained in the Public Works Appropriations Act of 1957 approved 2 July 1956 (Public Law 641, 84th Congress, 2nd Session).

3.03 Project Purposes. The Cooper Lake and Channels project is authorized for the purposes of flood control, water supply, and recreation.

STATUS OF PROJECT

3.04 Prior to May 1971 Injunction. Portions of the Cooper Lake and Channels project have been completed since authorization by Congress in 1955. Levee and channel work upstream of Cooper Lake along South Sulphur and Middle Sulphur Rivers was begun in 1958 and completed in 1959. The work consisted of 18.4 miles of realined river channel, clearing of a floodway along the realined channel, improvement of 7.4 miles of agricultural levees, modification of three drainage culverts, and alteration of three railroad crossings. The channel and floodway work consisted of realining the Middle and South Sulphur Rivers by excavation of a new channel and clearing a floodway.

Construction of the levee and channel improvements downstream of Cooper Lake commenced in September 1959 and continued intermittently as rights-of-way and funds became available. Lack of funds and spending limitations prevented construction of levees and channels between April 1964 and February 1971. These delays in the downstream work exposed previously completed levees to scour. During this period, flooding caused overtopping and degrading of the levees, silting of flapgate culverts, and flooding of adjacent farmland. Texas Highway 37 bridge was being exposed to damage due to debris accumulation on its substructure.

On 10 February 1971, a contract was awarded for construction and rectification of approximately 23 miles of levee and 33 miles of channel improvement and realinement of the Sulphur River between the Magnolia pipeline at mile 131 and US Highway 271 at mile 174. The work would have required approximately 1.5 years to complete. Additional contracts were to be let shortly thereafter. Previous flood damage to levees was to be repaired as work progressed through the area. In May 1971, however, the US District Court for the Eastern District of Texas, acting on a motion for preliminary injunction by the Texas Committee on Natural Resources, et al., halted further construction on the project until an environmental assessment was filed with the President's Council on Environmental Quality (CEQ).

The work downstream of Cooper Lake which had been completed by that time included the construction of about 15 miles of realined channel and floodway clearing and about 15 miles of agricultural levee improvement on Cuthand Creek and levee work and about 1 mile of realined channel and floodway clearing on Brushy Creek. Approximately 46,000 feet of channel floodway clearing was accomplished from Cuthand Creek upstream on the Sulphur River. In addition to clearing, approximately 16,000 feet of channel excavation was halted. Channel work on Cuthand Creek and Brushy Creek had been completed since 1959, as well as levee work related to these tributaries and the North Sulphur River. Approximately 5 miles of levee work on the South Sulphur River was completed. Up to the time of injunction, levee and channel work upstream of the reservoir was 100 percent complete, and work below the reservoir was approximately 50 percent complete. This condition is referred to as the status quo and is used as the base from which the impacts of all the alternatives were assessed. Existing levees and channels constructed by the Corps will be operated and maintained by local interests in accordance with operating agreements in effect.

3.05 After May 1971 Injunction. Subsequent to the court action, the Corps of Engineers requested a ruling as to the effects of the injunction upon planning, real estate acquisition, and other nonconstruction activities associated with the project. These functions were permitted by the court. As of the end of calendar year 1978, approximately 98 percent of the lands in the reservoir area had been acquired in fee.

Immediately after the court imposed the injunction against further construction, the Corps began to evaluate the factors relevant to the project and to prepare a draft EIS. The draft document was circulated

for review in June 1976, and on 31 July 1976, a public meeting was held to further examine the needs and desires of the general public. Based on the oral testimony delivered at the public meeting and written statements on the draft EIS, a decision was made to minimize further construction of the authorized channel and to follow an alternative course of action involving the construction of a reservoir, downstream levees, and limited channels only. This alternative plan provided essentially the same degree of benefit while foregoing the unnecessary destruction of aquatic habitat. This plan was the recommended alternative presented in the final EIS filed with CEQ on 24 June 1977.

3.06. December 1978 Memorandum Opinion. In November of 1977, the Texas Committee on Natural Resources, ET AL, filed a trial brief in United States District Court challenging the sufficiency of the final EIS for the Cooper Lake and Channels project filed with CEQ on 24 June 1977.

In challenging the sufficiency of the final EIS, plaintiffs raised numerous legal and factual issues. The asserted inadequacies of the EIS included, *inter alia*:

(1) absence of state agency comments, and failure to address those comments that were made;

(2) failure to set out, concurrently with implementation of the project, adequate mitigation measures for losses of fish and wildlife;

(3) failure to discuss the alternative of a water supply project without provision for flood control;

(4) inadequate explanation of nonstructural flood control management;

(5) bias in presentation of cost-benefit ratios and failure to analyze those presented; and

(6) lack of acequate discussion concerning the impacts associated with the allegedly likely conversion to water supply storage of storage space now allocated to flood control purposes in Wright Patman Lake.

On December 8, 1978, the United States District Court for the Eastern District of Texas issued a Memorandum Opinion in this case.

The court permanently enjoined the Corps of Engineers from continuing further with the Cooper Lake and Channels project until a new or amended EIS is filed correcting deficiencies noted in the Memorandum Opinion.

These deficiencies are the first five listed. The court ruled that conversion of flood control storage to water supply storage in

Wright Patman Lake was not an issue which had to be included in the EIS for the Cooper Lake and Channels project, so long as no final decision has been made on the conversion and that it is not an imminent action.

OBJECTIVES OF THE SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (EIS)

3.07 Purpose. The purpose of this supplemental EIS is to reevaluate and modify as necessary all previously considered alternatives for the Cooper Lake and Channels project, compare these alternatives with additional water supply only and comprehensive nonstructural alternatives, present and evaluate recommended fish and wildlife mitigative measures, present additional information and analysis of the costs and benefits of various alternatives identified, address State agency comments received but not included in the final EIS, and provide opportunity for additional Federal, State, and local agency comment, as well as comments from environmental and conservation groups and individuals on the identified alternatives. This supplemental EIS also updates information presented in the final EIS to respond to recent changes in environmental legislation, executive policy, and regulations pertaining to implementation of the National Environmental Policy Act of 1969.

3.08 Correction of Deficiencies of the Final EIS. State agency comments (deficiency (1)) received informally during coordination of the draft EIS are published in appendix A to this supplemental EIS along with the appropriate Corps response. A summary of the State comments is found in section VI. The State agencies have been provided a new opportunity to comment on the recommended plan and alternatives through coordination of the draft supplemental EIS. Deficiency (2) is addressed by presentation of mitigation requirements for alternatives and a mitigation plan for the recommended plan within the text of the supplemental EIS. Fish and wildlife coordination is included in more detail in appendix B. Inadequacies (3), (4), and (5) are addressed in the text of the supplemental EIS primarily in Section III - Alternatives and Section V - Environmental Effects. Supporting documentation is included in appendixes C, D, and E. An index is provided in table III-1.

Information and analyses in the final EIS filed on 24 June 1977 are incorporated by reference into this supplemental EIS, and the basic data developed for analyzing alternatives and environmental impacts which were included in the final EIS are not repeated in this supplemental EIS.

The five deficiencies of the Cooper Lake and Channels final EIS as described in the Memorandum Opinion dated 8 December 1978 all relate either directly or indirectly to plan formulation and selection of the recommended plan. To supplement the final EIS in a manner that would bring it in full compliance with the National Environmental Policy Act and the court order requires a reexamination of alternatives previously formulated and considered, development of alternatives specifically required by the court order (water supply without flood control and comprehensive nonstructural flood plain management), and development of alternatives needed to adequately address any concerns that may have surfaced during the reexamination process. These alternatives

TABLE III-1

INDEX TO DEFICIENCIES OF THE FINAL EIS

	Actions Taken Specifically to Address Deficiency	Where Found in Supplemental EIS: Supporting Appendix	Where Found in Supplemental EIS: Main Text Paragraph
1.	Procure deleted State agency comments and address officially	A	6.07
2.	Include adequate habitat mitigation plan and analyze impacts	B	1.04, 1.06, 3.34, 3.36, 5.02-5.05
3.	Water supply only alternative developed and displayed	D	3.15-3.19, 3.28, 5.04
4.	Non-structural alternative developed and displayed	D	3.20-3.22, 3.29, 5.05
5.	Display cost-benefit analysis	C	3.31

would be screened down to a final array and ultimately a plan would be selected for recommendation. The process just described is documented in detail in appendix D. Section II of appendix D deals with reexamination of the without project condition (status quo) and twenty-two alternative plans presented in the final EIS. Data on these alternatives remain as in the final EIS except where changes have resulted from correcting court-identified deficiencies and other minor discrepancies. Development of the alternatives required by the court, water supply and nonstructural, are documented in sections III and IV, respectively, of appendix D. Alternatives addressing concerns which surfaced during reexamination of final EIS alternatives are developed in section V of appendix D. Section VI of appendix D presents the alternatives selected for the new final array to be evaluated in this supplemental EIS and describes these alternatives in detail. It also presents fish and wildlife compensation requirements for each of these alternatives, gives evaluations of the alternatives, and documents the selection of the supplemental EIS recommended plan. Through this point, all analyses and data are shown based on 1974 conditions of development, flood plain modifications, land use, and prices. This is to retain general comparability with alternatives evaluated in the final EIS. In section VII of appendix D, the supplemental EIS recommended plan is reevaluated based on 1980 conditions and prices, including the Corps recommended mitigation plans.

ALTERNATIVES EVALUATED IN THE FINAL EIS

3.09 General. Nineteen structural and three nonstructural alternatives were considered in the final EIS. These alternatives were formulated to fully or partially respond to the Congressionally authorized purposes of the Cooper Lake and Channels project. Status quo was listed as the twenty-third alternative. It is actually the without project condition against which all alternative plans are evaluated.

The 23 alternatives considered in the final EIS were evaluated in a Plan Selection Report (General Design Memorandum No. 2-B, Revised, Supplement No. 1) approved 11 August 1977. That document provides informat[illegible] developed specifically for the final EIS, along with additional design, economic, social, and environmental data required for plan formulation but not normally included in an EIS.

3.10 Without Project Condition (Status Quo). The condition of the flood plain, including completed levee and channel systems, as it existed in 1974 was considered the without project condition. The term applied to this condition in the final EIS was "status quo." This condition was an alternative course of action, as well as the basis for evaluating all other alternatives.

The completed levee and channel systems in the without project condition include old levees originally constructed by individual farmers or groups of farmers, larger levee systems constructed later with authorization from State legislation, and Federal systems completed subsequently to the 1955 authorization of Cooper Lake and Channels.

Completed levee systems are shown with the final EIS recommended plan on plate B. Many of these levees have fallen to various stages of ineffectiveness due in part to large floods exceeding design without the stage lowering effect of Cooper Lake and lack of proper maintenance. With the exception of 1LS, existing levees which were still effective to varying degrees would become totally ineffective over time without additional flood control efforts in the watershed. The underlying assumption was that continued frequent floods exceeding levee designs without the lake would eventually cause farmers and levee districts to discontinue maintenance of the levees. This assumption is supported by the fact that some of the older and smaller levees have already been abandoned. Existing levees being operated under agreements with the Corps will be maintained in accordance with those agreements, or as subsequently modified by both parties.

The 30-year flood plain under the without project condition includes 58,000 acres of wooded land, 12,300 acres of semiwooded land, 18,900 acres of cleared land, and about 2,000 acres of levees and other nonagricultural land. Cleared and semiwooded lands were used predominately as pasture to support beef cattle production and dairy operations. Limited timber cutting was reported in wooded areas. Wooded areas were determined suitable for pasture if cleared and protected from floods. No land use or land cover changes for the flood plain were projected under the without project (status quo) condition, even though levees would become less effective.

Based on 1974 prices and conditions and 27 years of flood records, average annual agricultural flood damages were estimated to be $970,000. Average annual nonagricultural damages (fences, bridges, levees, etc.) were estimated to be $1,260,000 based on Corps of Engineers damage surveys on the floods of October to December 1971. Under without project conditions, inadequate municipal and industrial water supplies were projected for cities and urban areas served by the entities which have contracted for water storage in Cooper Lake. Although there is demand, recreation use in the area under without project conditions is low because of private ownership of lands and limited access to streams.

3.11 Structural Alternatives. Ten structural alternatives were evaluated in the final EIS which were considered fully responsive to the authorized project purposes of water supply, flood control, and recreation. Water quality control was deleted as a project purpose due to policy changes regarding dilution of pollutants by releases from reservoir storage. Table 1 of appendix D provides economic data on the 10 fully responsive alternatives shown in the final EIS. These data were extracted from the final EIS, Plan Selection Report, and supporting documents. Table 2 of appendix D provides readily quantifiable environmental data on the fully responsive alternatives which were also extracted from the final EIS, Plan Selection Report, and supporting documents.

Economic differences among the 10 alternatives, with the possible exception of the Reservoir and Channel alternative, are basically insignificant when considering the magnitude of the numbers and the accepted level of accuracy of these estimates. All 10 alternatives are shown to be justified with benefit-cost ratios of 1.4 or 1.5. On the

basis of net benefits, the Reservoir and Channel alternative would be favored from an economic standpoint, even though its benefit-cost ratio is slightly lower than the others. However, table 2 of appendix D shows that quantifiable environmental losses of the Reservoir and Channel alternative are significantly greater than those of the nine other alternatives. This is primarily due to the extensive channelization involved. In terms of absolute quantifiable terms, the Reservoir and Levee alternative would cause fewer environmental related losses than any of the others. It was considered the best of the fully responsive alternatives and was recommended in the final EIS.

Nine structural alternatives were evaluated in the final EIS which were considered partially responsive to the authorized project purposes of flood control, water supply, and recreation. Table 3 of appendix D provides economic data on the nine partially responsive alternatives shown in the final EIS. These data were extracted from the final EIS, Plan Selection Report, and supporting documents. Table 4 of appendix D provides readily quantifiable environmental data on the fully responsive alternatives which were extracted from the final EIS, Plan Selection Report, and supporting documents.

The data in table 3 show more variance in benefit-cost ratios and net benefits for the partially responsive alternatives than table 1 showed for the fully responsive alternatives. Even with $728,000 average annual flood control benefits added to the Reservoir and Nonrestrictive Easement, Reservoir and Restrictive Easement, and Reservoir and Fee Purchase alternatives (see note 1, table 3), they remain less desirable from an economic standpoint. The Channel Only, Levees Only, and Channel and Levees alternatives appear the most desirable economically, but they do nothing to address the critical water supply needs and the demand for recreational opportunities in the area. Although the Reservoir with Animal Refuge Mounds alternative is justified with a 1.4 benefit-cost ratio and $1,175,100 net benefits, it is not incrementally justified over the Reservoir Only alternative. The Reservoir and Selective Flood Proofing by Ring Levees alternative would be incrementally justified economically over the Reservoir Only alternative, but it would cause significantly greater environmental losses, as shown in table 4. Also, Reservoir Only would protect only 3,200 acres of wooded land while Reservoir and Selective Flood Proofing by Ring Levees would protect 14,000 wooded acres. It was assumed that 80 percent of protected wooded lands (mostly bottomland hardwoods) would be cleared.

Generally, the Reservoir Only alternative would cause as few or fewer environmental losses and as great or greater environmental benefits as any other partially responsive alternative. It addresses all three project purposes, although the area protected from 30-year level floods is less than under the authorized plan. It is economically justified with a 1.4 benefit-cost ratio and $1,188,800 net benefits. For these reasons, Reservoir Only was considered the best of the partially responsive alternatives.

3.12 Nonstructural Alternatives. The final EIS presents general descriptions and impacts of four categories of nonstructural flood damage reduction measures. These are flood plain regulation (zoning), flood plain acquisition, flood insurance, and flood warning and evacuation.

Measures in the categories of flood plain regulation, flood insurance, and flood warning and evacuation were dismissed without quantification and detailed consideration of costs, benefits, and environmental impacts. Under the flood plain acquisition category, three measures were quantified and evaluated in the final EIS with the 19 structural alternatives. The three plans discussed involved acquisition of 89,200 flood plain acres by fee purchase, restrictive easement, and nonrestrictive easement. They are covered in more detail in the final EIS and the Plan Selection Report.

Table 5 of appendix D provides economic data on the three nonstructural plans evaluated in the final EIS. These data were extracted from the final EIS, Plan Selection Report, and supporting documents. Table 6 of appendix D provides readily quantifiable environmental data which were also extracted from the final EIS, Plan Selection Report, and supporting documents. For many of the parameters evaluated in tables 5 and 6, the three nonstructural plans, as formulated, provide no significant change from the without project condition. In those cases, the net benefit will be zero.

3.13 Final EIS Recommended Plan. From the 22 alternatives and the without project condition (status quo) the Reservoir and Levees plan was selected and displayed as the final EIS recommended plan. The features of this plan are shown in detail on plate B. Features identified on this plate as completed or existing are part of the without project condition. The Reservoir and Levees plan consists of the multiple-purpose Cooper Lake; levee 4RSS spur; levee 4LSS extension; levee 3RS spur, strengthening, and extension; and a new levee 4RS channelization and floodway clearing would be required in conjunction with levees 4LSS and 4RS.

3.14 Final EIS Alternatives Eliminated from Further Consideration. After reexamination of alternatives formulated and considered in the final EIS and supporting documents, the Reservoir and Levees plan and the Reservoir Only plan were selected for the final array of alternatives to be evaluated in the supplemental EIS. These two plans were shown to be the most desirable, respectively, of the fully responsive and partially responsive plans considered previously in the final EIS. None of the nonstructural measures described in the final EIS were carried into the final array of the supplemental EIS as such. This was because the court did not view these nonstructural measures as true alternative plans but only as measures to be considered in the formulation of a comprehensive nonstructural plan. The formulation of a comprehensive nonstructural plan which was carried into the final array is described in section IV of appendix D. Measures presented in the final EIS, as well as additional nonstructural measures applicable to the Sulphur River flood plain, were reconsidered in the formulation of the comprehensive nonstructural plan.

WATER SUPPLY WITHOUT FLOOD CONTROL

3.15 Deficiency Noted in Memorandum Opinion. One deficiency noted by the court was the absence of consideration in the final EIS of an alternative to provide water supply without provisions for flood control. The National Environmental Policy Act of 1969 requires that an environmental impact statement must include analyses of all feasible alternatives no matter whether the responsible agency has the authority to implement them. The court therefore rejected arguments that a water supply alternative should not have been evaluated since the implementation of such a plan would not be the responsibility of the Federal Government under existing authorities. Furthermore, the court rejected arguments that the Corps had previously considered a water supply only alternative and that pertinent information on the impacts of such a plan could be extracted from data in the final EIS on the multiple-purpose Reservoir Only plan. Regulations of the Council on Environmental Quality (CEQ) specify that an environmental impact statement must be capable of being understood without undue cross referencing. Also, case law mandates that an environmental impact statement must be comprehensible to nontechnical minds. The operating characteristics, and consequently the impacts, of a water supply lake would be somewhat different in terms of pool elevations and releases than those of a multiple-purpose lake.

The court recognized that water supply was the primary concern of local interests and that it would be financially advantageous to the local sponsors to participate in a multiple-purpose project rather than to construct a water supply project totally at their own expense. This does not, however, relieve the Corps from considering all feasible alternatives, including a water supply only project.

In correcting the water supply only alternative deficiency, a water supply needs study with and without conservation measures, was first prepared for the Fort Worth District by the Southwestern Division Office of the Corps of Engineers. The areas studied include those served by the entities that have contracted for water from the proposed Cooper Lake. These are the North Texas Municipal Water District (NTMWD); the city of Irving; and the Sulphur River Municipal Water District (SRMWD) which will serve the cities of Commerce, Cooper, and Sulphur Springs (see figure 1 of appendix D for map of study area). Potential sources of water that could feasibly supply a portion or all of the identified needs of this study area were identified. The potential sources identified include those of other sources such as existing reservoirs, possible new reservoirs, and ground water sources. The water supply needs data were compared with the potential sources and a set of alternative plans to satisfy the needs was developed. Water supply needs are summarized in section II of this supplemental EIS and included in more detail in section III of appendix D.

3.16 Measures Evaluated. Potential sources of water supply to meet the needs of the NTMWD, the city of Irving, and the SRMWD were explored using various sources of information. Previous water supply studies by private consulting firms were used along with considering supplies that might be available from existing reservoirs, new reservoir sites, and ground water

sources. The geographical area considered was the lower section of the Red River Basin, the Sulphur River watershed, the Cypress Creek watershed, the Sabine River Basin, and the upper portion of the Trinity River Basin. Potential sources for each of the river basins are discussed in Section III of appendix D. See figure 2 of appendix D for a general map of the study area and figure 3 of appendix D for a more detailed map showing specific locations of the potential surface water supply sources investigated. Of 71 existing or potential surface sources investigated, all but 3 were eliminated due to no available yield, distance from the local sponsors, or no comparative advantages over the Cooper Lake site.

Two potential sources of water supply in the Red River Basin were considered in more detail. One would be to divert water from the Red River below Denison Dam (Lake Texoma) to a tributary of Lake Lavon to mix the water with Lake Lavon water. This would produce water that would meet the quality requirements of the Texas Department of Health Resources and the Environmental Protection Agency. Another source of water in this basin would be from a proposed reservoir located on Bois d'Arc Creek at approximately river mile 20. It is called New Bonham to distinguish it from the existing Lake Bonham and another proposed reservoir called Bonham Reservoir that has been studied by the Corps of Engineers. The Cooper site was the only reservoir source in the Sulphur River watershed carried into more detailed analysis.

Another consideration for potential water supply was additional utilization of ground water sources. At the request of the Fort Worth District, a study was prepared by the Texas Department of Water Resources (TDWR) on the availability and use of ground water supplies in the study area. This study, Ground-Water Resources of the Cooper Lake and Channels Project Area, is now published as exhibit 3 of appendix D. TDWR identified two major aquifers in the study area; the Trinity group and the Carrizo-Wilcox. Minor aquifers identified in the study area are the Woodbine and the Nacotoch. These aquifers could not provide a long range dependable water supply of adequate quality. There would be problems with extreme pumping lifts, water level declines, saline water encroachment, and undesirable concentrations of iron and fluoride. The rural areas will continue to depend on ground water as a source of water supply, but according to TDWR it is not a dependable long range source for more populated areas.

Return flows were also considered as a possible source of water supply. They generally equal about 60 percent of the average water usage. The effluents are currently discharged into rivers and streams where they are eventually purified through natural processes. These flows contribute to reservoir inflows and are therefore accounted for in the dependable yield of the reservoirs being considered. Return flows could not be used directly for general municipal and industrial uses unless the effluents were treated to drinking water standards. This would require a high standard of treatment which would be quite costly. There also could be considerable social concern over direct utilization of effluents.

3.17 Alternatives Evaluated. From the initial measures considered, a list of the most promising water supply measures for the study area was developed. The three most likely available sources found were diversion of water from the Red River below Lake Texoma, New Bonham Lake, and a lake at the Cooper site (see Figure 4 of Appendix D). Alternative plans for water supply were then formulated through various combinations of the most promising measures to develop a total of 109 mgd. In order for the costs of the water supply alternatives to be comparable, pipeline costs were included. These costs, where applicable, were for appropriate pipelines to Lake Lavon for supply to the NTMWD and the city of Irving, and to the Cooper area for supply to the SRMWD. Pipeline and pumping costs were estimated with the assistance of a command-oriented computer program (MAPS) developed by the Waterways Experiment Station for use in design and evaluation of water and wastewater plans.

From the three most promising surface supply sources described, six alternative plans were formulated to provide a total dependable yield of 109 mgd and deliver the water to the general vicinity of need in accordance with the water supply needs study. Plan No. 1 consists of obtaining 49 mgd from the Red River in 1990 and 62 mgd from New Bonham in 2000 and diverting the water into the Lake Lavon watershed allowing approximately 10 percent for transmission losses through the tributaries of Lake Lavon. Water for the member cities in the Sulphur River Municipal Water District would be provided by a small water supply lake with a yield of 10 mgd at the Cooper Lake site in 1990. Several of the other plans utilize the same supply sources but they would be built in different years.

Plan No. 2 involves New Bonham Lake being constructed first along with the 10 mgd yield Cooper Lake. The diversion from the Red River would be constructed in 2010. Plan No. 3 would be to construct a lake at the Cooper site in two stages with 60 mgd available in 1990 and the remaining 49 mgd available in 2010. Plan No. 4 would be to construct Cooper Lake to provide the full 109 mgd in 1990. Plan No. 5 which is somewhat different from the previous ones, involves obtaining 49 mgd from the Red River in 1990, 62 mgd from New Bonham Lake in 2000, and 10 mgd from Cooper Lake in 2020. The city of Cooper would continue to obtain their supply from Sulphur Springs Lake until the time that the lake at the Cooper site is built. Plan No. 6 involves constructing New Bonham Lake in 1990 and diverting water from the Red River in 2010. In this plan, the city of Cooper would obtain water from New Bonham Lake until 2020 when a 10 mgd yield Cooper Lake would be built. Table III-2 shows at a glance each feature of the six alternative water supply plans, the yield each would provide, and the year required. Table III-3 provides average annual costs, by feature, of the six alternative plans.

3.18 Selection of Best Water Supply Alternative. Primary concerns in selecting the most likely water supply only alternative were costs, environmental impacts, and implementability. Centralized environmental impacts were considered to be generally more desirable than dispersed impacts of similar total magnitude. The most likely Water Supply Only alternative is Plan No. 4 which is the 109-mgd Cooper Lake. The total average annual cost of this plan is $4,093,900 which makes it the second

TABLE III-2

WATER SUPPLY PLANS FORMULATED

WATER SUPPLY PLAN NO.

Year Built	1	2	3	4	5	6
1990	Red River 49 mgd Cooper 10 mgd	New Bonham 63 mgd Cooper 10 mgd	Cooper Stage I 60 mgd	Cooper 109 mgd	Red River 49 mgd	New Bonham 62 mgd
2000	New Bonham 62 mgd				New Bonham 62 mgd	
2010		Red River 49 mgd	Cooper Stage II 49 mgd			Red River 49 mgd
2020					Cooper 10 mgd	Cooper 10 mgd

TABLE III-3

AVERAGE ANNUAL COSTS FOR WATER SUPPLY ALTERNATIVES
(1974 Price Level; 3-1/4 Percent Interest, 1990-2090 Period of Analysis)

	WATER SUPPLY PLAN NO.					
	1	2	3	4	5	6
Red River Diversion	1,069,600	550,500 2/			1,069,600	550,500 2/
New Bonham Lake	1,207,400 1/	1,664,600			1,207,400 1/	1,664,600
Cooper Lake 10 mgd	1.127,900	1,127,900			430,000 4/	430,000 4/
Cooper Lake 109 mgd				2,106,400		
Cooper Lake Staged			2,299,800 3/			
Pipeline-New Bonham Lake to Lake Lavon tributary	1,249,100 1/	1,733,800			1,249,100 1/	1,733,800
Pipeline-Cooper Lake to Lake Lavon			1,987,500 3/	1,987,500 3/		
Pipleline-New Bonham Lake to Cooper area						109,400
TOTAL	4,654,000	5,076,800	4,287,300	4,093,900	3,956,100	4,488,300

1/ Discounted from 2000 to 1990.

2/ Discounted from 2010 to 1990.

3/ Stage II discounted from 2010 to 1990.

4/ Discounted from 2020 to 1990.

least expensive of the six plans since Plan No. 5 has a total average annual cost of $3,956,100. Plan No. 5 was rejected for two major reasons. First, the plan requires that the city of Cooper rely on Lake Sulphur Springs to meet its needs until the year 2020. Although the Corps of Engineers needs study indicates viability for such an arrangement, city officials of both Cooper and Sulphur Springs have emphasized that the existing service was intended to last only until a more dependable source of water is developed. The existing pipeline and pumping facilities were designed to be temporary and do not have the capacity of meeting future peak demands in Cooper. Secondly, Plan No. 5 was rejected also for dispersed environmental impacts. With Plan No. 5, as well as with the more expensive Plans 1, 2, and 6, adverse environmental impacts will occur at Cooper Lake, New Bonham Lake, and the Red River diversion whereas with Plan No. 4 the disruption of a similar total number of acres will occur only at the Cooper Lake site.

The environmental impacts of a staged lake (Plan No. 3) would be somewhat more acceptable than those of a lake initially constructed and filled to its ultimate size. The staged lake was shown to be more expensive, however, due to redundancies in design and construction requirements. Also, the full recreation potential of a staged project would be delayed.

Table III-4 gives pertinent data and Table III-5 presents a detailed breakdown of the 1974 cost of the 109 mgd Cooper Lake designed to provide water supply without flood control. Pipelines and pumping costs will be omitted from this point on since this plan will be further evaluated with multiple-purpose lakes at the Cooper site.

3.19 Water Supply Only Alternative with Recreation. Recognizing that any public body of water will attract recreation visitors, the Water Supply Only alternative will include minimum facilities to provide for the health and safety of these visitors. This is consistant with recognized health and safety standards and generally with the practice of non-Federal water supply developers in the State of Texas. These facilities would consist of guardrails, turnarounds, and frame toilets at five locations on existing road ends and guardrails and turnarounds at five other locations on existing road ends. The 1974 cost of these facilities is $780,000. Additionally, the public would have access to two boat ramps which would be provided primarily for proper management of project lands and waters. The estimated 1974 cost of these boat ramps is $82,000.

These costs are included in the best Water Supply Only alternative evaluated in the supplemental EIS.

COMPREHENSIVE NONSTRUCTURAL FLOOD PLAIN MANAGEMENT ALTERNATIVE

3.20 Deficiency Noted in the Memorandum Opinion. The basic deficiency with respect to non-structural planning was that no credible attempt was displayed in the final EIS to develop a comprehensive, implementable flood plain management plan. Four measures or methods of nonstructural flood damage prevention were discussed, and three variations of flood plain acquisition were displayed in the final EIS as alternatives.

TABLE III-4

PERTINENT DATA
Cooper Lake -- 109 mgd Water Supply Only

Location: River mile 23.2 of the South Sulphur River

Purposes: Water supply with minimum recreation facilities for health and safety

Drainage Area: 476 square miles

Type of Dam: Earthfill

Spillway: 275 feet concrete service spillway with crest of uncontrolled ogee at elevation 440.0 feet. 4,200 feet uncontrolled emergency spillway with crest at elevation 449.8 feet

Outlet Works: 5 feet diameter gated conduit with intake invert at elevation 410.0 feet

Reservoir:

Feature	Elevation (ft msl)	Surface Area (acres)	Pool Capacity (acre-feet)	Total Capacity (acre-feet)	Spillway Discharge (cfs)
Top of dam	459.8	--	--	--	--
Maximum design water surface	454.3	27,494	231,936	646,224	157,000
Guide taking line	445.0	22,075	104,288	414,288	--
Water supply pool	440.0	19,305	273,000	310,000	--
Sediment pool	415.5	5,084	37,000	37,000	--
Stream bed	386.0	0	0	0	--

Reservoir Yield: 109 mgd (169 cfs)

TABLE III-5

FIRST COST, INVESTMENT, AND ANNUAL OM&R
Cooper Lake - 109 mgd Water Supply Only

(1000's of dollars; 1974 price level)

Account Number	Item	Cost
01	Lands and damages	$ 9,215
02	Relocation	2,440
03	Reservoir	2,329
04	Dam	30,797
08	Roads	512
11	Levees	245
14	Health and Safety Facilities	780
19	Buildings, grounds and utilities	194
20	Permanent operating equipment	192
Subtotal		$46,704
Engineering and Design		3,561
Supervision and Administration		3,036
Total First Cost		$53,301
Interest During Construction (4 years at 3-1/4%)		3,465
Total Investment		$56,766
Annual Operation, Maintenance, and Replacements		$ 183.2

These flood plain acquisition measures were also displayed in combination with a reservoir in the final EIS. The Court noted also that full benefit/cost information on nonstructural alternatives was lacking in the final EIS. This information is now included in section I of appendix C for the final EIS nonstructural alternatives, which have now been reformulated into an integrated plan along with other measures for flood plain management.

3.21 Development of a Comprehensive Nonstructural Flood Damage Reduction Plan. None of the nonstructural measures discussed in the final EIS can individually economically reduce flood damages in the Sulphur River flood plain. Rather, the nonstructural measures must be integrated to provide a viable plan. Existing land use of the Sulphur River flood plain is predominantly agricultural with practically no additional structural development forecast for the foreseeable future, and since damages to existing structures or facilities within the flood plain constitute only a portion of the existing average annual damages, any approach to comprehensive nonstructural flood plain management for the entire 30-year flood plain as a viable alternative must be based primarily on implementing those societal preferences for restoring and preserving natural and beneficial flood plain values. These preferences are expressed as concepts in the Water Resources Development Act of 1974, Executive Order 11988 on Flood Plain Management, Water Resources Council's Unified National Program for Flood Plain Management (1976), the National Flood Insurance Act of 1968, the Flood Disaster Protection Act of 1973, Principles and Standards for Water Resource Development Planning (1973), the President's Water Policy Initiatives of July 12, 1978, and Corps implementing policy and regulations. The Clean Water Act, Executive Order 11990, and the Chief of Engineers Wetland Policy also relate to the current societal preferences for restoring or preserving natural and beneficial flood plain values.

In order to manage the lands within the Sulphur River flood plain to reduce existing flood damages or accommodate flooding, three approaches may be taken. One of these involves changing the land utilization of part or all of the cleared, semiwooded, and wooded bottomland to a land use subject to less economic damage from flooding. Such a land use could be converted to agricultural products more compatible with the flood hazard and/or to a recreational use such as leasing for hunting or fishing. The second approach would be to floodproof to some degree existing fences, levees, roads, bridges, and houses. A third approach involves combining land use changes and floodproofing measures into an aggregate plan that considers societal preferences as well as reduces flood damage.

The Fort Worth District was aided in the development of a Comprehensive Nonstructural Flood Damage Reduction plan by the consulting firm of Sheaffer and Roland, Inc. The firm, in conjunction with district personnel, applied a multi-disciplinary approach to developing the concepts for a nonstructural plan. The concepts were then carried forth by the Fort Worth District.

Recognizing the status quo condition of the Sulphur River flood plain, and the future projected for that flood plain in the 1977

Alternative Plan Studies utilized for the final EIS, one best Comprehensive Nonstructural Flood Damage Reduction plan was formulated from measures considered in the final EIS and new measures considered in developing the supplemental EIS. A detailed discussion of formulation of the Comprehensive Nonstructural plan is found in section IV of appendix D.

3.22 Selection of Best Nonstructural Alternative. The Comprehensive Nonstructural Flood Damage Reduction plan is basically a voluntary land use plan which suggests uses for flood plain lands compatible with the flood hazard. Implementation of the plan would be left up to individual landowners, but encouragement to participate would come through public awareness and technical assistance. Moreover, an incrementally justified recreation plan was formulated to function in concert with the flood damage reduction aspects of the Nonstructural Flood Damage Reduction plan.

The plan accomplishes flood damage reduction primarily by reducing expenditures for damages to fences and for supplemental feeding of cattle due to lost grazing time during and after flooding. To a lesser extent, expenditures related to flood damaged structures are also reduced. The nonstructural measures recommended to achieve flood damage reduction include dividing the flood plain into zones, restricting future structural development, maintaining certain existing levees, technical assistance, and floodproofing residential structures.

The key factor of the nonstructural plan with regard to flood damage reduction is the division of the flood plain into voluntary land use zones which will promote uses compatible with the flood hazard. These zones are on 3-year frequency flood plains containing 66,200 acres which should remain in wildlife habitat, or gradually revert to habitat where grazing uses are occurring in the status quo condition. Selective timber harvest is also a suggested compatible use. About 24,200 acres of this land in a corridor along the river is suggested for public recreation uses. The second zone is designated a cultivated zone which extends between the 3-year and 30-year flood plain. Within this zone, cultivation of row crops, as well as uses for grazing, habitat, and selective timber harvest, would be suggested. Above the 30-year flood plain and along the sloping valley adjoining the Sulphur River, grazing uses are suggested so that soil erosion is minimized. Figures 6 and 7 of appendix D illustrate the zoning concept.

Other measures incorporated into the comprehensive plan are: (1) all counties would enroll in the National Flood Insurance Program and zone the flood plain to prevent new structures unless they are floodproofed to the 100-year elevation; (2) Levees 5RSS and 1RS would be maintained to provide at least a 3-year frequency protection to developed agricultural land; (3) two houses on State Highway 37 would be floodproofed to the 100-year elevation; (4) damageable farm equipment should be moved to areas outside the flood plain for storage when not in use; and (5) technical assistance to implement the zoning plan would be made available through the Soil Conservation Service, Texas A&M Agricultural Extension Service, and the Corps of Engineers.

The recreation feature of the plan consists of public acquisition of a 24,200 acre corridor within the 3-year flood plain and along the South Sulphur and Sulphur Rivers. Nine parks within this corridor would be developed to provide access and facilities for public use.

An analysis was also made of combining the best Comprehensive Nonstructural plan, including the recreation corridor concept, with the water supply only Cooper Lake in order to develop a primarily nonstructural plan which could also meet the water supply needs of the study area. This analysis is presented in section IV of appendix D. This plan was not carried into the final array, however, due to the need for different entities to implement various parts of a combined plan under current known authorities. In other words, the Nonstructural plan would require implementation by landowners, counties downstream, or levee districts, and the Water Supply Only project by the local water supply sponsors. While these two plans could be considered together, they are really two separate plans which complement each other. Neither is fully implementable under current Corps authorities.

STRUCTURAL MULTIPURPOSE ALTERNATIVES

3.23 Alternatives from Final EIS. Based on analysis summarized in paragraphs 3.09-3.14 and included in detail in appendix D, the Reservoir and Levees alternative was determined to be the best fully responsive structural plan to authorized purposes, and the Reservoir Only plan was the best partially responsive structural plan. A reanalysis of the remaining downstream levee work proposed in the Reservoir and Levees plan (plate B) was then conducted to determine if there were other feasible structural alternatives which could reduce environmental impacts, particularly on wooded areas, and consequently mitigation requirements, while still retaining most flood control benefits of the alternative. Reduction of sediment transport downstream was also a consideration.

3.24 Additional Structural Multipurpose Alternatives Considered. Section V of Appendix D contains detailed cost information and analysis of three modifications to the Reservoir and Levees plan. One of these was a Reservoir and Levees plan with designed stable channels rather than self-eroding 12-foot pilot channels. This would improve esthetics of the downstream area, and prevent unnecessary sediment transport to Wright Patman Lake which would occur with eroding channels. The second alternative was a Reservoir and Levees plan with levees realigned to eliminate the need for new channels. The principal benefit of the modification would be the elimination of stream impacts by downstream works. This modification would protect about the same acreage as the Reservoir and Levees plan. A third modification was to construct a reservoir and strengthen Levee 3RS, which is an existing levee. Levee 4LSS and 4RS, shown on plate B, would not be constructed as they are new levees.

Each of the modifications to the Reservoir and Levees plan adequately address concerns over erosion and subsequent sedimentation problems resulting from self enlargement of the required channels. The problems would be solved either by designing the required channels to be

stable, realigning levees 4LSS and 4RS to eliminate the need for channelization, or including only levee 3RS which requires no channelization. Conversely, induced clearing of bottomland hardwoods and wetlands persists with each of the three alternatives. Two of the alternatives would provide 30-year protection to practically the same wooded acreages as would the Reservoir and Levees plan. Although the third alternative would protect fewer wooded acres, protection afforded to cleared and semicleared lands would also be significantly reduced. None of the three structural multiple-purpose alternatives described were considered in the final array presented in this supplemental EIS. These alternatives were dropped early for a composite of reasons involving the degree of incremental economic justification and environmental impacts which resulted in no significant advantages over the Reservoir Only plan and the Reservoir and Levees plan, both of which were considered in the final array.

FINAL ARRAY OF ALTERNATIVES - SUPPLEMENTAL EIS

3.25 Selection of Final Array. From the 22 alternatives considered in the final EIS, water supply only alternatives without flood control, non-structural measures and alternatives, and modifications to the Reservoir and Levees plan discussed in appendix D, an array of four alternatives was established for evaluation and selection of the best overall plan. These alternatives are the best fully responsive and the best partially responsive structural multiple-purpose alternatives from the final EIS (Reservoir and Levees, Reservoir Only), the best Water Supply Only alternative (Cooper Lake without flood control), and the Comprehensive Nonstructural plan. The No Action alternative is also displayed.

3.26 Reservoir and Levees. The Reservoir and Levees plan recommended in the final EIS is reevaluated in this supplement. A brief plan description is included in table III-6, and a more detailed description and analysis is found in section VI of appendix D. Minor changes in detailed cost estimates in the final EIS have been made for this plan and are detailed in appendix D. The USFWS has provided new data relating to fish and wildlife benefits/losses, and water supply benefits have also been revised from data presented in the final EIS to reflect a more accurate estimate of water supply costs to local sponsors.

3.27 Reservoir Only. The Reservoir Only alternative is also reevaluated in this supplement. This plan partially meets all four project purposes, but does not fulfill the flood control purpose as well as the Reservoir and Levees plan. It is reevaluated due to its potential to reduce downstream environmental impacts significantly over the Reservoir and Levees plan. The minor changes in detailed costs, fish and wildlife benefits/losses, and water supply benefits displayed in appendix D also apply to this plan.

3.28 Water Supply Only. This alternative is the most likely non-Federal single purpose water supply source to meet identified needs for water supply in the service area. A brief description is presented in table III-6 and a more detailed description is included in paragraph 3.18. Recognizing that a body of water will attract recreational use,

TABLE III - 6

SUMMARY COMPARISON OF ALTERNATIVES

(1974 LAND USE AND PRICE LEVELS)

	RESERVOIR & LEVEES (FINAL EIS RECOMMENDED PLAN)	RESERVOIR ONLY (FINAL SEIS RECOMMENDED PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO - PROJECTED)
PLAN DESCRIPTION	A multiple-purpose (flood control, water supply, recreation) dam & lake would be constructed at river mile 23.2 of the South Sulphur River. The recreation and water supply pool would require 19,305 acres. The flood control pool has 131,400 acre-feet of storage and would include 3,435 acres at the 30-year frequency flood event. Flood protection would be provided to 12,900 acres of land. Recreation facilities would be provided initially in two park areas, with ultimate development of seven areas totalling 3,300 acres. Twenty-seven miles of downstream levees and 6.6 miles of channels would be constructed to provide 30-year flood protection to 11,400 acres.	A multiple-purpose (flood control, water supply, recreation) dam & lake would be constructed at river mile 23.2 of the South Sulphur River. The recreation and water supply pool would require 19,305 acres. The flood control pool has 131,400 acre-feet of storage and would include 3,435 acres at the 30-year frequency flood event. Flood protection would be provided to 12,900 acres of land. Recreation facilities would be provided initially in two park areas, with ultimate development of seven areas totalling 3,300 acres. About 1 mile of Spur 4RSS levee would be required in conjunction with the outlet works for the reservoir.	A single-purpose water supply only lake would be constructed at the Cooper dam site by one or more of the local sponsors. The water supply pool would require 19,305 acres. A total of 22,075 acres of land would be acquired for the project. Recreation facilities consisting of boat ramp access and minimum facilities for health and safety are expected to be provided by the local sponsors, the county, or the state of Texas on acquired lands above the water supply pool.	A largely voluntary land use zoning plan would be implemented by landowners based on expected flood frequency within the flood plain areas, soil types, and erosion hazards. Abandonment of fencing to reduce damages would also be implemented, and two houses would be floodproofed within the flood plain. The plan identifies 66,200 acres of primarily wooded land within the 3-year frequency flood plain, which should remain in wildlife habitat with timber management and flood compatible uses. Hay cropping, with high revenues and low flood damage risk is recommended between the 3- and 30-year flood plain zones, and a pasture zone is recommended on slopes above the 30-year flood plain. To meet recreation needs, a 24,200 acre corridor within the 3-year flood plain is recommended for public acquisition and management for fish and wildlife, and stream-oriented recreation.	The existing flood plain condition with completed portions of levees and channels constructed by the Corps and by local interests, at the date of the May 1971 court injunction is considered the status quo base condition for evaluation of alternatives. The no action alternative consists of projecting the most probable future condition of the flood plain in the absence of the implementation of other alternatives considered for the Cooper Lake and Channels Project authorization.
QUANTIFIABLE IMPACTS					
1) ECONOMICS					
FIRST COST					
a. Project Plan	68,182,000	58,108,000	53,301,000	10,133,000	Not applicable
b. Habitat Mitigation	16,432,000	8,997,000	8,338,000	0	
Total	84,614,000	67,105,000	61,639,000	10,133,000	
AVERAGE ANNUAL CHARGES	1/	1/	1/	1/	
a. Project Plan	2,971,700	2,598,100	2,106,400	630,600	
b. Habitat Mitigation	724,100	403,000	359,100	0	
Total	3,695,800	3,001,100	2,465,500	630,600	
AVERAGE ANNUAL BENEFITS					
a. Flood Control	1,305,000	741,000	0	183,100	
b. Water Supply	2,671,500	2,671,500	2,671,500	0	
c. Redevelopment	293,200	249,500	208,400	0	
d. Recreation	1,111,500	1,111,500	136,500	795,000	
e. Fish & Wildlife	255,200	269,400	132,500	31,700	
Total	5,636,400	5,042,900	3,148,900	1,009,800	
BENEFIT/COST RATIO	1.5	1.7	1.3	1.6	
NET BENEFITS	1,940,600	2,041,800	683,400	379,200	
2) ENVIRONMENTAL					
a. LOSSES (DEGRADED OR LOST)					
TERRESTRIAL HABITAT (ACRES)	34,965	25,405	21,345	2,400	0
STREAM HABITAT (MILES)	37	21	21	0	0
b. GAINS (CREATED OR ENHANCED)					
TERRESTRIAL HABITAT (ACRES)	8,655	8,655	630	66,200	0
LAKE HABITAT (ACRES)	19,305	19,305	19,305	0	0
OXBOWS (ACRES)	96	0	0	0	0

1/ Benefit/cost analysis includes charges for terrestrial habitat mitigation, and Senate Document 97 values for fish and wildlife, recreation benefits. Net sport hunting losses and trapping losses are retained though they would be partially offset.

	RESERVOIR & LEVEES (FINAL EIS RECOMMENDED PLAN)	RESERVOIR ONLY (FINAL SEIS RECOMMENDED PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO - PROJECTED)
3) SOCIAL-ECONOMIC (LANDUSE)					
a. LANDS PROTECTED (30YR)					
WOODED (ACRES)	11,900	3,200	0	0	Not Applicable
SEMI-WOODED (ACRES)	3,300	1,500	0	0	
CLEARED (ACRES)	9,100	8,200	0	0	
b. LANDS INTENSIFIED (WITH PROJECT LAND USE)					
WOODED (ACRES)	2,380	640	0	3,200 (Timber Pro-	
NATIVE PASTURE (ACRES)	5,820	1,900	0	0 duction)	
IMPROVED PASTURE (ACRES)	12,500	8,420	0	0	
HAY CROPPING (ACRES	3,600	1,940	0	12,700	
c. PROJECT LANDS REQUIRED (ACRES)	30,800	30,000	22,075	24,200	
d. PROPERTY VALUES (NET)	-$5.3 MILLION	-$3.4 MILLION	-$7.9 MILLION	-$4.2 MILLION	
e. TAX REVENUES (NET)	-$19,500	+$24,600	-$22,000	-$77,800	
PARTIALLY QUANTIFIABLE IMPACTS ON SIGNIFICANT RESOURCES					
1) ENDANGERED SPECIES	No impacts on designated critical habitat. Impacts on listed migratory and resident species occurring or potentially occurring in the affected area have been determined to be insignificant.	No impacts on designated critical habitat. Impacts on listed migratory and resident species occurring or potentially occurring in the affected area have been determined to be insignificant.	No impacts on designated critical habitat. Impacts on listed migratory and resident species occurring or potentially occurring in the affected area have been determined to be insignificant.	No impacts on designated critical habitat. Impacts on listed migratory and resident species occurring or potentially occurring in the affected area have been determined to be insignificant.	No impacts on designated critical habitat. Impacts on listed migratory and resident species occurring or potentially occurring in the affected area have been determined to be insignificant.
2) FISH & WILDLIFE	Wildlife productivity would be lost on 34,965 acres of lands inundated or degraded in habitat quality. Existing stream fishery would be lost on 37 miles of the South Sulphur and Sulphur River, and flows would be modified downstream from the dam, enhancing some species and adversely impacting others. A lake fishery would be created.	Wildlife productivity would be lost on 25,405 acres of lands inundated or degraded in habitat quality. Existing stream fishery would be lost on 21 miles of the South Sulphur River, and flows would be modified downstream from the dam, enhancing some species and adversely impacting others. A lake fishery would be created.	Wildlife productivity would be lost on 21,345 acres of lands inundated or degraded in habitat quality. Existing stream fishery would be lost on 21 miles of the South Sulphur River and flows would be modified downstream from the dam, enhancing some species and adversely impacting others. A lake fishery would be created.	Wildlife productivity would be improved on 9,900 acres of land in the 3-year flood plain due to conversions from open and semi-cleared land to wooded. About 2,400 acres of semi-wooded land would be cleared.	No change in wildlife productivity. Habitat would be controlled by the landowner.
3) WETLANDS	Approximately 80% of the wooded area intensified (7,616 acres) meet criteria for wetlands. These areas plus 600 acres of wetlands impacted by levee & channel construction and about 80 acres impacted by dam construction would be irretrievably lost. Wetlands within the reservoir would be inundated. The primary value of the affected wetlands is wildlife habitat.	Approximately 80% of the wooded area intensified (2,048 acres) meet criteria for wetlands. About 80 acres of wetlands would be impacted by dam construction, and wetlands within the reservoir would be inundated. The primary value of the affected wetlands is wildlife habitat.	About 80 acres of wetlands would be impacted by dam construction, and wetlands within the reservoir would be inundated. The primary value of the affected wetlands is wildlife habitat.	About 46,400 acres of wetlands areas with the 3-year flood plain would slightly improve in quality as wildlife habitat.	The 46,400 acres of wetlands areas would remain essentially in the same condition. Protection of values and future land use changes affecting wetlands would be controlled by the private landowner subject to existing Federal and State control by various regulatory programs.
4) CULTURAL RESOURCES	The lake and dam construction will cause the loss of about 90 identified archeological sites, some of which have been determined eligible to the National Register (Cooper Lake District). Remaining sites on public lands will be protected. Mitigation by salvage of data has been completed. The levee alignment will affect one known site of undetermined significance.	The lake and dam construction will cause the loss of about 90 identified archeological sites, some of which have been determined eligible to the National Register (Cooper Lake District). Remaining sites on public lands will be protected. Mitigation by salvage of data has been completed.	The lake and dam construction will cause the loss of about 90 identified archeological sites, some of which have been determined eligible to the National Register (Cooper Lake District). Remaining sites on public lands will be protected. Mitigation by salvage of data has been completed.	No significant adverse impact on identified cultural resources. Cultural resources on the 24,200 acre corridor would become publicly owned.	No change. Existing sites would remain privately owned and subject to exploitation or protection by the individual landowner.

	RESERVOIR & LEVEES (FINAL EIS RECOMMENDED PLAN)	RESERVOIR ONLY (FINAL SEIS RECOMMENDED PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO - PROJECTED)
5) ENERGY RESOURCES	Fossil fuels would be committed to construction. The reservoir will affect slightly the development of oil and gas potential on reservoir lands thru increased costs or environmental controls on drilling within the lake or perimeter lands. There are no fossil fuel resources affected by the downstream levees. Loss of value of energy resources is included in land costs.	Fossil fuels would be committed to construction. The reservoir will affect slightly the development of oil and gas potential on reservoir lands thru increased costs or environmental controls on drilling within the lake or perimeter lands. Loss of value of energy resources is included in land costs.	Fossil fuels would be committed to construction. The reservoir will affect slightly the development of oil and gas potential on reservoir lands thru increased costs or environmental controls on drilling within the lake or perimeter lands. Loss of value of energy resources is included in land costs.	No significant impact on energy resources.	No change.
6) AGRICULTURAL ACTIVITY	Net change in agricultural activity attributed to this plan is a gain of about $58 million.	Net change in agricultural activity attributed to this plan is a gain of about $28 million.	Net change in agricultural activity attributed to this plan is a loss of about $9.5 million.	Net change in agricultural activity would be a loss of about $3.2 million.	Flood losses to agricultural property would continue.
7) LAND USE	19,305 acres of rural land converted to water, 920 acres converted to structures, and 9,775 acres converted to multiple use of recreation, flood control, fish and wildlife habitat. 24,300 acres of downstream lands enhanced thru flood control, and private land adjoining the lake enhanced in value and will undergo conversion to subdivisions and businesses over time.	19,305 acres of rural land converted to water, 920 acres converted to structures, and 9,775 acres converted to multiple use of recreation, flood control, fish and wildlife habitat. 12,900 acres of downstream lands enhanced thru flood control, and private land adjoining the lake enhanced in value and will undergo conversion to subdivisions and businesses over time.	19,305 acres of rural land converted to water, 920 acres converted to structures, and 1,750 acres converted to multiple use of recreation, flood control, fish and wildlife habitat. Private land adjoining the lake enhanced in value and will undergo conversion to subdivisions and businesses over time.	24,200 acres of wooded land within the 3-year flood plain would be committed to public from private use, but would not change significantly in land use.	No change.
8) ENVIRONMENTAL QUALITY, AIR AND WATER POLLUTION, NOISE, AND ESTHETICS	Temporary adverse impacts. Permanent change in type of esthetic value on 30,800 acres of project lands and water, seen as an improvement by some and adverse by others. Indirect land use change will replace 9,520 acres of wooded land and 3,300 acres of semi-wooded land with pasture. Long-term impacts on air and water quality not significant. Slight increase in recreation noise.	Temporary adverse impacts. Permanent change in type of esthetic value on 30,000 acres of project lands and water, seen as an improvement by some and adverse by others. Indirect land use change will replace 2,560 acres of wooded land and 1,500 acres of semi-wooded land with pasture. Long-term impacts on air and water quality not signigicant. Slight increase in recreation noise.	Temporary adverse impacts. Permanent change in type of esthetic value on 22,075 acres of project lands and water, seen as an improvement by some and adverse by others. Long-term impacts on air and water quality not significant. Slight increase in recreation noise.	Slight improvement in esthetic quality on lands in 3-year flood plain, and in the 24,200 acre public corridor. No significant adverse or beneficial effects on air or water quality. Slight increase in recreation noise.	Current environmental condition would continue subject to Federal, State and local laws and regulations. No change.
9) SOCIAL/ECONOMIC	21 people relocated. A net increase of about 26,400 persons to Delta and Hopkins Counties is expected by the year 2,040 due to the plan.	21 people relocated. A net increase of about 26,400 persons to Delta and Hopkins Counties is expected by the year 2040 due to the plan.	21 people relocated. A net increase of about 26,400 persons to Delta and Hopkins Counties is expected by the year 2,040 due to the plan.	No change in population, no relocations.	Present trends would continue.
FISH & WILDLIFE HABITAT MITIGATION REQUIREMENTS					
1) TERRESTRIAL HABITAT FULL COMPENSATION REQUIREMENTS (MID-LEVEL DEVELOPMENT)	Acquisition and management of 45,788 acres of bottomland hardwoods, and 10,919 acres of semi-wooded habitat is required for full in-kind compensation. The Corps plan recommends 46,800 acres total.	Acquisition and management of 21,424 acres of bottomland hardwoods, and 8,359 acres of semi-wooded habitat is required for full in-kind compensation. The Corps plan recommends 25,500 acres total	Acquisition and management of 19,885 acres of bottomland hardwoods, 7,723 acres of semi-wooded habitat and 3,925 acres of openland is required for full in-kind compensation. The Corps plan recommends 25,500 acres total.	Full compensation in-kind for semi-wooded losses would require 14,316 acres to be acquired and managed. However, mitigation is considered inappropriate for this plan due to overall habitat productivity gains.	None.
2) AQUATIC MITIGATION	The USFWS recommends a continuous release from Cooper Lake of 45 cfs from September thru February, 50 cfs in March and April, and 30 cfs the remainder of the year for partial compensation of stream losses. The Corps recommends 5 cfs continuous release and utilizating 5% flood pool storage.	The USFWS recommends a continuous release from Cooper Lake of 45 cfs from September thru February, 50 cfs in March and April, and 30 cfs the remainder of the year for partial compensation of stream losses. The Corps recommends 5 cfs continuous release and utilizing 5% flood pool storage.	The USFWS recommends a continuous release from Cooper Lake of 45 cfs from September thru February, 50 cfs in March and April, and 30 cfs the remainder of the year for partial compensation of stream losses. The Corps recommends 5 cfs continuous release.	None.	None.

costs for anticipated minimum development for health and safety, and boat ramp access are added to this plan, and estimated benefits for anticipated recreational use are claimed. This plan partially meets three project purposes.

3.29 Comprehensive Nonstructural. The best Comprehensive Nonstructural Flood Plain Management plan has been summarized in paragraph 3.22. Recreation development and acquisition of a corridor is incrementally justified based on estimates of recreational use, and these features are included in the plan. A local sponsor would be required, and the Texas Parks and Wildlife Department, by phone contact with staff, indicates no interest in such development. The recreation concept is retained for plan evaluation, however.

3.30 No Action Alternative. This is the projected future condition without any of the four plans. It has been described in paragraph 3.10.

EVALUATION OF ALTERNATIVES

3.31 Benefit-Cost Analysis. A detailed analysis of methodology for each benefit category claimed for the four alternatives included in the final array is found in section II of appendix C. Detailed cost estimates for each alternative are found in appendix D. A summary of all quantifiable benefits and costs is displayed in table III-6. Tables III-7 and III-8 include an assumed analysis of benefits relating to recreation and fish and wildlife utilizing values from Principles and Standards, and claiming the lowest benefit within the range provided for lake recreation and the highest for fish and wildlife losses. This is displayed for comparative purposes only in response to the Memorandum Opinion.

The benefit/cost analysis yields two parameters for economic evaluation of alternatives; the benefit/cost ratio and net benefits. The benefit/cost ratio is a measure of rate of return on the total investment and should exceed unity for an investment to be economically justified. Net benefits give the difference between average annual costs and benefits and should be maximized for economic optimization of scale of a project. From table III-6 it can be noted that although all four alternatives are economically justifed, both the benefit/cost ratio (i.e. rate of return) and net benefits are maximized with the Reservoir Only plan. This plan would clearly be the preferred alternative from an economic standpoint.

3.32 Environmental Impacts. Impacts, direct and indirect, of the four plans on significant environmental resources are described in section V of this supplemental EIS, and displayed comparatively in table V-1. Quantifiable and partially quantifiable impacts from Section V are summarized in table III-6. The Reservoir and Levees plan provides 30-year flood protection to 24,300 acres of agricultural land along the South Sulphur and Sulphur Rivers; 273,000 acre-feet of water supply storage in Cooper Lake and the potential for an additional 120,000 acre-feet of water supply storage in Wright Patman Lake for municipal and industrial water supply; 933,200 recreation days of various

TABLE III-7

RECREATION AND FISH AND WILDLIFE BENEFITS
BASED ON ASSUMED PRINCIPLES AND STANDARDS VALUES 1/
(NO MITIGATION)

Activity	Reservoir & Levees		Reservoir Only		Water Supply Only		Nonstructural	
	Gain/Loss Mandays	Value $	Gain/Loss Mandays	Value $	Gain/Loss Mandays	Value $	Gain/Loss Mandays	Value $
General Recreation	+741,000	+555,750	+741,000	+555,750	+182,000	+136,500	+530,000	+397,500
Fish & Wildlife								
1) Sport Fishing								
Stream	- 2,252	- 20,286	- 2,254	- 20,286	- 2,254	- 20,286	0	0
Lake	+192,202	+144,152	+192,202	+144,152	+ 96,100	+ 72,075	0	0
2) Sport Hunting								
Deer	- 2,010	- 18,090	- 1,265	- 11,385	- 886	- 7,974	+ 1,442	+ 12,978
Raccoon	- 846	- 7,614	- 502	- 4,518	- 337	- 3,033	+ 1,551	+ 13,959
Rabbit	- 1,846	- 16,614	- 1,296	- 11,664	- 1,040	- 9,360	+ 760	+ 6,840
Quail	- 108	- 972	- 166	- 1,494	- 181	- 1,629	- 190	- 1,710
Squirrel	- 8,987	- 80,973	- 5,415	- 48,735	- 3,525	- 31,725	+ 7,948	+ 71,532
Dove	0	0	0	0	0	0	- 85	- 765
Coyote	- 199	- 1,791	- 237	- 2,133	- 270	- 2,430	+ 303	+ 2,727
Fox	+ 14	+ 126	+ 40	+ 360	+ 42	+ 387	+ 27	+ 243
3) Commercial								
Stream Fishing		- 844		- 844		- 844		0
Lake Fishing		+ 9,708		+ 9,708		+ 9,708		0
Trapping		- 2,626		- 1,705		- 1,285		+ 2,843
4) Total Fish & Wildlife		+ 5,788		+ 51,456		+ 3,604		+108,647

1/ \$0.75/man-day for general recreation and lake fishing; \$9.00/man-day for sport hunting and stream fishing

TABLE III-8

ECONOMIC ANALYSIS OF ALTERNATIVES BASED ON ASSUMED PRINCIPLES AND STANDARDS VALUES 1/

	Reservoir and Levees	Reservoir Only	Water Supply Only	Nonstructural
First Cost	$68,182,000	$58,108,000	$53,301,000	$10,133,000
Average annual charges	2,971,700	2,598,100	2,106,400	630,600
Average annual benefits				
a. Flood control	$1,305,000	$ 741,000	$ 0	$183,100
b. Water supply	2,671,500	2,671,500	2,671,500	0
c. Redevelopment	293,200	249,500	208,400	0
d. Recreation	555,750	555,750	555,750	397,500
e. Fish and Wildlife	5,800	51,500	3,600	108,650
Total	$4,831,250	$4,269,250	$3,020,000	$689,250
Benefit-cost ratio	1.6	1.6	1.4	1.1
Net benefits	$1,859,550	$1,671,150	$913,600	$58,650

1/ Assumes no mitigation for net fish and wildlife losses. High range values (9.00/manday) are assumed sport hunting and stream fishing losses. Low range values ($0.75/manday) are assumed for general recreation and lake fishing. Display is for comparative purposes only.

recreation opportunities per year; and about 10,000 acres of perimeter project lands to be managed for fish, wildlife, recreation, and flood storage purposes. Adverse impacts include inundation of 19,305 acres and 21 miles of stream; levee and channel construction on approximately 800 acres; induced clearing of 12,820 acres of wooded and semiwooded lands, 7,600 acres of which are considered to be wetlands; temporary air, noise, and water pollution during construction; periodic inundation of all or part of 3,435 acres in the flood control pool; and realignment of 16 miles of river with channel construction. To compensate for fish and wildlife habitat losses would require acquisition and management of 48,600 acres of primarily wooded land and development of perimeter lands at an average annual cost of $724,100. This compensation would mitigate partially for monetary wildlife losses of about $38,600.

Beneficial impacts of the Reservoir Only plan include 30-year flood protection to 12,900 acres of agricultural lands; 273,000 acre-feet of municipal and industrial water supply storage in Cooper Lake with the potential for 120,000 acre-feet in Wright Patman Lake; 933,200 annual recreation days of recreational opportunities; and management of 10,000 perimeter acres for fish, wildlife, recreation, and flood control storage. Adverse impacts include inundation of 19,305 acres and 21 miles of stream; induced clearing on 4,060 acres of wooded and semiwooded lands, 2,000 acres of which are considered to be wetlands; periodic inundation of all or part of 3,425 acres in the flood control pool; and temporary air, noise, and water pollution during construction. Proposed compensation for fish and wildlife habitat losses includes acquisition and management of 25,500 acres of primarily wooded land and development of perimeter lands at an average annual cost of $403,000. This compensation would partially mitigate for wildlife monetary losses of about $24,400.

The beneficial impacts of the Water Supply Only plan include 273,000 acre-feet of storage for municipal and industrial water supply and about 275,000 recreation days of recreational opportunities annually. Adverse impacts include inundation of 19,305 acres and 21 miles of stream and temporary air, noise, and water pollution during construction. Compensation for fish and wildlife habitat losses would require acquisition and management of 25,500 acres of primarily wooded habitat at an annual cost of $359,100. Compensation would partially mitigate for $17,200 in monetary wildlife losses.

Beneficial impacts of the Nonstructural plan include allowing 9,900 acres of semiwooded and cleared land in the 3-year flood plain to revert to bottomland hardwoods; increased habitat value on 24,200 acres in the recreation corridor; 542,000 recreation days of recreational opportunities annually; reduction of fence damages in areas where the need for fences is reduced; and increased productivity on land in the 3- to 30-year flood plain through conversion from grazing to hay production. Adverse impacts include reduced productivity on agricultural land in the 3-year flood plain; removal of 24,200 acres from private ownership; and reduced habitat value on the 3- to 30-year flood plain due to conversion to hay production and clearing of 2,400

semiwooded acres. No compensation for fish and wildlife habitat losses would be required with the Nonstructural plan.

3.33 Social-Economic Impacts. Direct and indirect impacts of the four plans on significant social resources, including impacts on land use, population, tax revenues, and overall economic productivity are described in section V of this supplemental EIS and displayed comparatively in table V-1. Quantifiable and partially quantifiable impacts from section V are summarized in table III-6. The Reservoir and Levees plan would take the most land out of private use, including mitigation, but would increase property value and agricultural productivity the greatest of the four plans. The Reservoir Only plan retains net increases to tax revenues and agricultural productivity while the Water Supply Only plan retains no net increases. The Nonstructural plan is the worst in terms of losses in agricultural productivity, tax revenues, and property value. The social impacts in terms of relocations and population changes are about the same for the three structural plans and are not significant for the Nonstructural plan.

3.34 Mitigation Requirements. Aquatic and terrestrial mitigation requirements for each of the four plans were provided by the USFWS in a Planning Aid Letter dated August 19, 1980, and formalized in a current Coordination Act Report included in appendix B. Fish and wildlife habitat losses anticipated with each of the four alternatives and measures required to compensate for these losses are described in detail in Appendix B, Fish and Wildlife Coordination and Mitigation Plans. Initial terrestrial compensation plans were developed in terms of numbers of acres of wooded, semiwooded, and cleared lands in areas upstream of Wright Patman Lake that could be developed to a level that would fully compensate for project losses. The Corps then developed justified mitigation plans for each alternative. Cost evaluation of terrestrial mitigation for each plan is detailed in appendix B and summarized in section VI of appendix D. Cost of proposed terrestrial compensation was a criteria used in evaluating the four plans, and this data is included in table III-6.

PLAN SELECTION

3.35 Reservoir Only. Based on evaluations and assessment of impacts of the four alternatives of the final array, the Reservoir Only plan was selected for implementation (plate C). This plan was shown to be the best economically both in terms of benefit-cost ratio (1.68) and average annual net benefits ($2,041,800). The plan would satisfy the municipal and industrial water supply needs of local sponsors through the year 2030, as well as make possible the conversion of 120,000 acre-feet of flood control storage in Wright Patman Lake to water supply. The plan would provide 30-year flood protection to 12,900 acres, over 75 percent of which are either cleared or semiwooded. In contrast, although the Reservoir and Levees plan would provide 30-year protection to 24,300 acres, the cleared and semiwooded portion would only be 50 percent. The remaining 11,900 acres are wooded, consisting almost exclusively of bottomland hardwoods and wetlands. The Reservoir Only plan would require almost one-half the acres of land to compensate for fish and wildlife habitat losses as would the Reservoir and Levees plan and the Water Supply Only plan.

The Nonstructural plan would cause fewer and less severe environmental impacts and is the most environmentally preferable plan, but it would not satisfy water supply needs without the addition of a reservoir and would be rather uncertain in terms of flood damage reduction and intensification output due to the voluntary nature of the agriculture zoning portion of the plan.

3.36 Recommended Fish and Wildlife Mitigation Features. For the Reservoir Only plan, the USFWS recommended a 33,400 acre tract of land upstream of Wright Patman Lake, along White Oak Creek, which would fully compensate for all habitats adversely impacted by the project. A full evaluation of the USFWS recommended plan is presented in appendix B.

The Corps accepts, in part, the recommendation of the USFWS to acquire and manage the White Oak Creek area for compensation of net terrestrial habitat losses due to the Reservoir Only selected plan. The Corps does not believe acquisition of the 33,400 acre full compensation area is justified to optimize the overall project. The acquisition and management of lands to compensate for bottomland hardwood losses is deemed justified, as this is a recognized significant habitat and is decreasing in quantity. The Corps recommends the acquisition, development, and management of a tract of land within the compensation area recommended by USFWS, which will compensate primarily for bottomland hardwood losses and will incidentally contribute to offsetting net adverse losses in productivity of semiwooded habitat. This tract has been defined by the Corps to consist of about 25,500 acres, including 20,300 acres of bottomland hardwood habitat. The area will be fenced, and initial development will be applied to create a wildlife management area to offset bottomland hardwood losses due to the implementation of the Reservoir Only Cooper Lake project. Operation and maintenance costs will be budgeted to maintain the wildlife management area. The area is shown on plate D.

In addition to the above mitigation area, the Corps also recommends the following actions to further compensate for net adverse terrestrial wildlife losses, including semiwooded habitat losses.

a. A 751-acre tract of bottomland wooded habitat between Cooper dam and Highway 19/154 will be acquired in fee. The majority of this area is flooded with the 3,000 cfs maximum release, and a flowage easement is required. The Corps proposes to acquire the land in fee rather than flowage easement so that full public wildlife value can be developed, and trail systems can be implemented within the area.

b. During master planning for recreation development and land resource management on lands acquired for Cooper Lake, all perimeter lands not required for project operation or immediate recreation development will be designated for wildlife management purposes, or in the case of recreation land, interim wildlife management. Vegetative plantings and land management practices will be applied to these lands during construction to offset wildlife losses greater than natural succession processes would.

c. An initial development cost for wildlife habitat development of perimeter lands will be budgeted. Operation and maintenance charges for continued management of these project lands will also be budgeted. The USFWS in their current Coordination Act report concurred in the Corps recommended terrestrial mitigation plan as acceptable compensation for project losses.

Implementation of the above mitigation plan will mitigate fully for significant habitats (bottomland wooded) adversely impacted by the Reservoir Only plan, will reduce adverse social and economic impacts of additional land acquisition to a minimum since primarily lands already encumbered by a flowage easement at Wright Patman Lake will be acquired. The recommended mitigation plan will be the most economically efficient in terms of minimizing economic productivity and tax losses and utilizing, in part, land which must be acquired for Cooper Lake anyway.

Table III-9 presents cost analysis of the Corps recommended terrestrial habitat mitigation plan for the Reservoir Only selected plan.

By Planning Aid Letter dated August 19, 1980, and subsequent recommendations in a current Coordination Act report, the USFWS recommended a continuous downstream flow release schedule from Cooper dam (after normal operating pool is reached) of 45 cfs for the months of September through February, 50 cfs for the months of March and April, and 30 cfs for the months of May through August. This schedule was recommended for an average water year, with two contingency plans reducing the recommended downstream releases during drought cycles. The USFWS also evaluated the Corps proposed operating plan which provides for a 5 cfs continuous low flow release when there are no flood pool releases.

The Corps does not accept, in total, the USFWS recommended downstream flow releases. Full rationale and discussion for rejection of continuous downstream releases is presented in appendix B. Primarily these relate to a determination by the Corps that the requested flows are more appropriately defined as optimum releases rather than mitigation for identified stream losses, the limited alternatives available and constraints with regard to water supply contracts for Cooper Lake, and the existing restricted type and quality of the stream fishery affected by Cooper Lake. It is recognized that the flows requested would significantly enhance the downstream fishery if constraints were not in effect.

The Corps does recommend the following aquatic (stream) mitigation features to be included in the Reservoir Only selected plan.

a. Public access to stream fishery be provided on lands acquired for Cooper Lake, including stream area downstream . om the dam to Highway 19/154.

b. Public access to stream fishery be provided on all lands acquired for terrestrial habitat mitigation.

TABLE III-9

COST ANALYSIS - CORPS TERRESTRIAL MITIGATION PLAN
RESERVOIR ONLY

(1974 Price Levels)

Habitat Type	Acres Required	Cost/ Acre	Total Land Cost ($1000)	Development Cost/Acre	Development Cost ($1000)
BLHW	20,345	135	2746.6	62	1,261.4
OPEN/SW	5,189	275	1427.0	0	0
TOTAL	25,534		4173.6		1,261.4

MITIGATION AREA - WHITE OAK CREEK	
Costs	($1000)
Lands	4173.6
Damages & Contingencies	1794.6
Administrative	77.6
Total Acquisition Cost	6045.8
Total Development Costs	1261.4
Fencing (60 miles X $10,300/mi)	618.0
Subtotal	7925.2
E&D	237.4
S&A	175.3
Total First Cost	8337.9
Interest & Amortization	282.5
O&M ($3/acre/year)	76.6
Subtotal Average Annual Charges - Mitigation Area	(359.1)
PROJECT LANDS - COOPER LAKE	
Costs	
Incremental Acquisition Cost (Downstream 3000 cfs release areas)[1]	190.0
Development costs (revegetation of project lands)	387.5
Subtotal	577.5
E&D	48.4
S&A	33.6
Total First Cost	659.5
Interest & Amortization	22.3
O&M ($3/acre/year X 7,200 acres)	21.6
Subtotal Average Annual Charges - Project lands, mitigation	(43.9)
TOTAL AVERAGE ANNUAL CHARGES - CORPS TERRESTRIAL MITIGATION PLAN	403.0

[1]Cost difference between purchasing flowage easement on 641 acres downstream of dam, and purchase in fee of 751 acres.

c. The operating plan for Cooper Lake will provide for the retention of the lower 5 percent (1/3 foot) of the flood pool whenever the reservoir is at or above this stage. Higher release rates to preserve the flood control storage purpose will be maintained above the 5 percent pool, or storage may be evacuated when flood conditions are forecast. Releases will be made from this retained flood storage at the rate recommended by USFWS (45 cfs in September through February, 50 cfs for March and April, and 30 cfs for other months) until the lake is again at conservation pool. A 5 cfs constant low flow will be maintained downstream whenever the lake elevation is below 440 feet msl.

These release rates and periods may be modified in the future to optimize beneficial downstream effects, after conducting appropriate hydraulic studies, coordination with the USFWS and TPWD, and when such modifications would not adversely affect the flood control function of the project.

Appendix B includes a summary response to each USFWS recommendation included in the Coordination Act reports dated July 13, 1966, September 3, 1976, and Planning Aid Letters provided during the 1980 HEP and aquatic instream flow analysis. Appendix B also includes the current Section 2(b) Coordination Act report.

Full implementation of the proposed terrestrial mitigation plan will require funding amounting to about 10 percent of the total estimated project cost. It is recognized that the recommended public acquisition of an additional 25,500 acres of land within the Sulphur River basin is a significant additional impact and increases the scope of the Cooper Lake project considerably in relation to past land acquisition proposals. The major quantifiable adverse impacts of the recommended mitigation plan are direct economic (the additional cost), indirect economic (the foregoing of future private economic pursuits on private lands and loss of tax revenue to local governments), and social (the conversion of private property to public ownership to benefit the public interest). Tradeoffs for these quantifiable adverse economic and social impacts are largely unquantifiable and intangible, and economic returns are slight. The decision that acquisition of the White Oak Bayou area for terrestrial wildlife mitigation purposes is justified, is therefore based primarily on; (1) the major wildlife resource lost as a result of inundation and flood control in Cooper Lake (bottomland wooded) is recognized as significant; (2) the mitigation plan to fully compensate for these habitat losses can be implemented within a reasonable percentage of cost of the total project; (3) the total recommended project including mitigation remains economically viable (1.7 BCR at 1974 price levels); (4) the indirect economic and social impacts of land acquisition have been minimized due to developing an acquisition plan which utilizes lands partially limited in private productive value already, requiring no relocation of people, and expanding adverse tax revenue impacts over four counties.

Over 80 percent of the lands proposed to be acquired in the White Oak Bayou area are wooded and have a low revenue producing capability

limited primarily to selective timber harvest and some grazing. Projections made by the Corps of Engineers for the 1974 base year evaluation are that those lands will remain largely uncleared and this assumption was used in the HEP analysis. Between 1974 and 1980, there have been no identified major changes in overall flood plain or project land use which would significantly change quantity or quality of environment parameters. About 1,200 acres of bottomland wooded habitat along the Sulphur River near Highway 37 and adjacent to existing (status quo) levee 3RS have been cleared and put into crop production. An after-the-fact Section 404 regulatory permit is being processed on this clearing operation due to part of the area being determined to be wetlands. There is additional landowner interest in pursuing clearing and levee construction in at least three other sites within wetland areas of the Sulphur River flood plain, one within the proposed mitigation area. Each of these proposed actions, if pursued by the landowners, will affect wetlands and require application by the landowner and review by the Corps of Engineers in accordance with the Section 404 permit program. The outcome of all of these applications and their effect on projected future of bottomland wooded habitat is unknown at this time. The actual evidence of clearing in the Sulphur River flood plain between 1974 and 1980 is not deemed significant enough to warrant a change in the projected future of bottomland hardwoods used in the 1974 HEP analysis, or to modify the quantity of mitigation recommended.

3.37 1980 Analysis. Section VII of appendix D presents the Reservoir Only recommended plan (including mitigation features) at March 1980 cost and benefit levels. Total average annual benefits for flood control, recreation, water supply, and fish and wildlife at 1980 price levels amount to $7,307,500. Total first cost of the selected plan under 1980 price levels is $112,167,000, and average annual charges are $4,993,400. The benefit-cost ratio is 1.46.

SECTION IV - AFFECTED ENVIRONMENT

SECTION IV - AFFECTED ENVIRONMENT

4.01 General. The draft and final EIS filed for the Cooper Lake and Channels project contains a detailed description of physical, biological, and cultural resources within the Sulphur River Basin. Appendices A-E filed with the draft EIS and appendices F-H of the final EIS contain additional detailed information on certain resources of the Sulphur River Basin. Those documents and the information in them are hereby incorporated by reference into this supplemental EIS. A brief discussion of the environmental setting of the Sulphur River Basin follows for orientation purposes.

Certain resources located within the Sulphur River Basin and potentially affected by alternatives developed for the Cooper Lake and Channels project are considered significant. These include resources identified in laws, regulations, executive orders, and other institutional guidelines or standards of national, regional, and local public agencies; those resources which derive significance from their scarcity, fragility, or importance locally, even though relatively abundant regionally or nationally; those resources for which impacts on them by a project are irreversible should the priorities or resource emphasis of future generations change; and those resources which are irretrievably committed in the construction or operation of a project. Those resources determined significant for the Sulphur River Basin based on public input and meetings, coordination of the draft and final EIS for the Cooper Lake and Channels project, and from evolving national emphasis and policy, are discussed following the basin setting.

ENVIRONMENTAL CONDITIONS

4.02 Basin Setting. The Sulphur River Basin is located in northeast Texas and southwest Arkansas. The river originates in Hunt County near Greenville, Texas, and flows eastward for about 300 miles to its confluence with the Red River in Arkansas. The oblong basin averages 25 miles in width and includes portions of 11 counties in Texas and 1 county in Arkansas, all within the northwest part of the Gulf Coastal Plain geologic and physiographic province. Channel bottom gradients along portions of the natural river vary from about 0.5 to 5.0 feet per mile with channeled and realined gradients increased to about 5.0 feet per mile. The flood plains of the Sulphur River and its major tributaries are 1 to 2 miles wide, increasing downstream to as much as 3 to 5 miles where the stream enters the Red River.

Basin climate is subtropical and dominated by Gulf maritime tropical air masses. Average temperatures are 64°F in January, and 83°F in August with an average growing season of 255 days. Precipitation ranges from 38 to 47 inches through the basin and averages 41 inches basinwide annually. Three inches of that average precipitation occurs as snow. Peak precipitation occurs in the spring with relatively dryer conditions in August and September.

The Sulphur River drains an area of about 3,700 square miles with the mainstem formed from the North and South Sulphur Rivers. The Sulphur River carries about 1,360 acre-feet of sediment a year into Wright Patman Lake with an annual flow of 1,670,000 acre-feet. The South Sulphur discharges about 140 acre-feet of sediment with an annual flow of 275,300 acre-feet. The Sulphur River and its tributaries are subject to frequent flooding.

Channelization along practically the entire length of the North Sulphur and subsequent erosional enlargement of the channel have practically eliminated agricultural damages along that reach. The enlarged channel, though, has reduced time of storm runoff so that peak discharges of the North Sulphur are materially greater than those on the South Sulphur even though its watershed is much smaller. In times of high flows, increased surface runoff dilutes the reappearing ground water which is mineral enriched and water quality remains high except for the increased sediment load. During low flow, ground water reentering the surface water along with evaporation results in higher concentrations of dissolved solids and degradation of water quality. Water quality data indicate, however, that most parameters are within acceptable limits for public water supply. Parameters existing in high concentrations include iron, arsenic, zinc, chemical oxygen demand, and total Kjheldal nitrogen, and with the exception of iron, are probably derived from man's activities.

The watershed includes three major vegetational areas, Pineywoods, Post Oak Savannah, and Blackland Prairie, which occurs in broad belts across the basin and are controlled by the diversity of soil types from east to west. The total forest area within the basin is approximately 608,000 acres, some of which is included in a narrow band of flood plain along the Sulphur River. The pineywoods area is in the eastern portion of the basin and extends into Arkansas. The forests are predominately pine (152,000 acres) and pine-hardwood (107,000 acres) and are restricted to the acid upland soils bordering the flood plain. The Post Oak Savannah area lies in the central portion of the basin and is restricted to the slightly acid claypan soils which extend across the region. The western part of the basin extends into the Blackland Prairie vegetational area. This is an open grassland community virtually free of trees except in stream areas. The soils are alkaline to slightly acid clays, generally fertile, and productive. Historically, most of the flood plain was wooded but much has been cleared for crop and livestock production. Basin flood plains are frequently flooded, poorly to somewhat poorly drained, very slowly permeable, neutral to slightly acid clays. Less clayey, better drained soils occur along the riverfronts and low ridge areas.

Although cotton has been a major cash crop in the area since the mid-19th century, none of the counties rank in the top 10 in Texas cotton production. Significant changes in farm management programs began occurring when soils became depleted from overuse in a one-crop economy. Croplands utilized for improved pastures have almost doubled

in the past 30 years, with agronomic croplands declining by more than half during the same period. The regional trend, however, is toward development of improved pasture rather than use of old cropland or woodlands for grazing.

About 62 percent of the study area is in farms. Better than one-half of that farmland is wooded, especially in the eastern Pineywoods portion of the basin where commercial forestry is an important industry. Roughly 30 percent of the basin's cropland is used only for pasture with 20 percent of the basin's farm area in hay crops, cotton, sorghums, and soybeans. The study area is not highly urbanized with about 59 percent of the urban population in 1970 located in the cities of Texarkana (Texas part, population 30,497), Paris (23,441), Greenville (22,043), and Sulphur Springs (10,642). Between 1960 and 1970 the study area showed a relatively slow net growth with an immigration rate of 1.2 as compared to 1.5 for the State of Texas.

Throughout the Sulphur River Basin, archeologists have found evidence of man from the prehistoric stage of the Paleo-Indians through the historic stage of the Caddo Indians. Though evidence of Paleo-Indian (10,000-3500 B.C.) occupation has been documented in isolated or scattered finds, no actual Paleo-Indian sites have been reported. The Archaic stage in East Texas (3500 B.C. to about 500 B.C.) is better documented in the Sulphur River Basin, particularly in downstream areas. The recognized sequences of the Caddo Cultural Complex and the transition period, are well documented in the Sulphur River Basin with Caddo I and II best represented along the South and Middle Sulphur Rivers, and Caddo III, IV, and V represented along the mainstream Sulphur River. At least 283 sites have been recorded in archeological survey and testing work in the Sulphur River Basin.

The historic settlement pattern of the 12 counties in the Sulphur River and Red River Region was influenced by the presence of climate and soils supportive of a subsistence economy similar to the Old South, a location providing a gateway to Texas and more western regions from the more developed areas of the United States, and a history of early exploration.

The land was never occupied by the French, Spanish, or Mexicans, however, providing a free area for migrants from the United States. Economic factors also influenced settlement during the depression of 1837 when southern farmers moved from the cotton belt westward into the Republic of Texas, and again during Reconstruction and the Depression of 1873. The cotton plantation economy continued, and as in the Old South, depleted the soils.

The change of agricultural patterns was slow to develop. Many of the descendants of the original settlers still live in the region. The development of towns first occurred with trading posts and military forts, then along routes of migration, and some towns originated with organization of counties. With the coming of railroads new towns appeared and some old towns were abandoned or relocated.

SIGNIFICANT RESOURCES

4.03 Endangered Species. The area potentially affected by alternatives under study in this supplement is known habitat or former habitat of a number of species of fauna listed as endangered by the USFWS (Federal Register, 17 January 1979). Wandering or migrating Bald eagles, *Halieetus leucocephalus*, are occasionally sighted in counties of the Sulphur River Basin. There are no known active or recently active nests in Northeast Texas. Similarly, the Arctic Peregrine Falcon, *Falco peregrinus tundrus*, also may migrate through the area in route to wintering areas along the Texas Coast. The American alligator, Alligator *mississippiensis*, has a former range extending into the lower Sulphur River Basin. The Arkansas Game and Fish Commission manages a population of released alligators on the Sulphur River Wildlife Management Area in Miller County, Arkansas. The Sulphur River Basin also includes the former range of the Red-Cockaded woodpecker, *Picoides borealis*, and the Red Wolf, *Canis lupus baileyi*, though these species are not known to occur there now. There are no endangered species of fish or invertebrates known to occur in this area. The study area also includes the range of one species of flora proposed for listing as endangered (Federal Register, 16 June 1976). This is *Coreopsis intermedia*, known from sandy wooded habitat in Franklin County and several other counties of East Texas. Species not listed as endangered but warranting special notice include a small stand of American chestnut trees, *Castanea dentata*, located about 10 miles north of the Sulphur River near the community of Box Elder, and the nutmeg hickory, *Carya myristicaeformis*, a rare hickory in North America which is fairly abundant in the lower Sulphur River Basin.

4.04 Fish and Wildlife. The importance of the Sulphur River Basin as fish and wildlife habitat was addressed in a US Fish and Wildlife Service Coordination Act Report on the Cooper Lake and Channels Project furnished in accordance with the Fish and Wildlife Coordination Act on 13 July 1966. On March 8, 1972, the USFWS prepared a second letter report on the project, and on September 3, 1976, the USFWS furnished an additional report recommending compensation planning for unavoidable wildlife losses as a result of the authorized project. In the 1976 report the fish and wildlife resources were described in part as follows:

> Fish and wildlife resources in the vicinity of the proposed reservoir and downstream area are plentiful and diverse due to the variety of aquatic and terrestrial habitats. While fishery resources are limited by narrow channels and seasonal low flows above the damsite, areas downstream support an abundance of forage, game and rough fish. Below the confluence of North Sulphur and South Sulphur Rivers, the stream has altered its course many times, leaving numerous oxbow lakes and sloughs. These lakes and the Sulphur River are connected during periods of high water, thus enabling natural restocking and nutrient exchange. These lakes also serve as spawning and rearing ponds for many species of fish.

Wildlife resources occur in moderate to high populations within the various habitat types. The pastures and croplands which occur primarily within the reservoir site and upper portions of the project channels support huntable populations of bobwhite quail, mourning dove, and cottontail rabbit. Many nongame species including songbirds, raptors, and small mammals are present. Semi-wooded pastures and bottomland hardwoods associated with the flood plain provide excellent habitat for numerous game and nongame species. White-tailed deer, fox squirrels, raccoon, cottontail rabbits, swamp rabbits, opossum, mink, beaver, and resident wood ducks occur in moderate to high numbers within these woodland and riparian ecosystems. Resident wood ducks and migrating waterfowl and American woodcock are also benefited by seasonal flooding of flood plain woodlands and cleared lands during the winter and spring months. Many species of songbirds, nongame mammals, reptiles, and amphibians are present due to the natural flooding conditions and excellent food and cover available.

While negotiations by the Corps and USFWS continued for incorporation of appropriate and justified mitigation into the proposed Cooper Lake project during coordination of the draft and final EIS, no specific plan involving land acquisition or wildlife habitat compensation using project lands was finalized or presented in these documents. The failure to present such a plan was recognized as one inadequacy of the EIS sited for the project in the December 8, 1978 Memorandum Opinion. The Corps of Engineers, USFWS, and the Texas Parks and Wildlife Department have continued working on appropriate mitigation requirements to compensate for fish and wildlife habitat losses as a result of this project or its alternatives presented in this supplement. Appendix B presents data on the Fish and Wildlife Coordination aspects and proposed mitigation recommendations.

4.05 Wetlands. Executive Order 11990, issued May 24, 1977, and Section 404 of the Clean Water Act have given National emphasis to the importance of wetlands as in situ wildlife habitat and nesting or nursery areas, and as areas which may be important for water quality maintenance, flood storage, groundwater recharge, and esthetics. The Chief of Engineers also has issued a policy of avoidance and protection of wetlands in accordance with these National policies in administration of both the Civil Works and Regulatory Programs.

The 30-year flood plain of the portion of the Sulphur River basin under study contains about 91,200 acres. Historically, most, if not all, of this flood plain was covered by a hardwood forest consisting of species tolerant to periodic overflow flooding from the Sulphur and South Sulphur rivers. With conversion of forest to agricultural use, due in part to levee and channel construction by local interests, and in part to work done by the Corps of Engineers under the Cooper Lake and Channels

authorization and others, there now remains about 58,000 acres in flood plain forest vegetation. In the absence of further alteration of flood plain hydrology through protection by structural features, this acreage receives flooding to the extent that generally prevents its economical conversion to a more intensified agricultural use, though selective clearing and logging do occur periodically.

The composition of the remaining flood plain forest is controlled by microsite variation in soil drainage characteristics, elevation, and man-made disturbances. The frequency and duration of overflow and the development of soils as a result of drainage and hydrology and disturbance by man all contribute to the vegetation make-up present on any given site. Two general flood plain forest types were recognized in surveys conducted by East Texas State University, (1) a riverfront type and (2) ridges, flats, sloughs, and swamps behind the riverfront. The riverfront sites are natural levees and included mostly sandy, well-drained soils and may not be considered true wetlands even though overstory species present reflect tolerance to flooding. The other type included forest dominants consisting primarily of hackberry, ash, and elm. On the drier low ridges and flats, bitter pecan, water oak, willow oak, hickories, post and blackjack oaks, boxelder, and black locust were found. More poorly drained sites supported cedar elm, bitter pecan, willow oak, hackberry, and locust. A generally sparse understory included dogwood, hawthorns, possum haw, American beauty berry, swamp privet, red bud, red cedar, and various vines.

Due to the variation of elevations, soil characteristics and vegetational patterns within the flood plain, it is difficult to delineate what is or is not a wetland without a specific on-the-ground analysis of each area under consideration. However, based on backwater flooding calculated from historical floods at the Hagansport gage, 40,000 acres of wooded flood plain land are subject to flooding at a gage height of 41.0. This stage was reached historically at least once in each of the 27 years of record (1945-1971), and a stage of 41.0 or higher was recorded 94 times in 27 years, or more than 3 times per year on the average. In 15 years out of 27 years of record, a gage height of 43.5 or greater was reached. Duration of overbank flooding varies from 2-3 days up to 86 days (1957 flood) during the growing season. Therefore, based on these stage area curves, a minimum of 40,000 acres or 70 percent of the remaining flood plain forest is expected to receive annual overflow under the status quo conditions, and an additional 7,000 acres would be expected to receive river overflow approximately once every 2 years. Considering the frequency and duration of flooding, local rainfall infiltration on the relatively flat flood plain, the poorly drained nature of the soils, and the existence of sloughs and swamps, it is estimated that at least 47,000 acres of the 58,000 acres of remaining flood plain forest, or 80 percent, are an overflow forest wetland type. The remaining 20 percent would be more properly classified as bottomland hardwood forest and not true wetland. Most of this wooded acreage is east of Highway 37 (Hagansport gage). For practical purposes, there is

very little difference in values for in situ wildlife habitat, esthetics, nesting or resting areas, water quality maintenance or groundwater storage between the bottomland forest and overflow forest, since overbank flooding is of short duration and relatively high frequency (several times a year at channel overbank to 30 year frequency near the flood plain edge), and the vegetational composition is not significantly different over broad areas. Non-forested wetlands in the flood plain include a number of natural or man-made oxbow lakes and drainage channels and sumps resulting from past agricultural development.

4.06 Cultural Resources. The Historic Preservation Act of 1966, the Preservation of Historical and Archeological Data Act of 1973, and Executive Order 11593 give special national emphasis to resources included in or eligible for listing to the National Register of Historic Places. A total of 283 archeological and historical sites have been recorded in the Cooper Lake project area and in the Sulphur River Basin downstream of the dam. This includes about 140 sites recorded for Wright Patman Lake. Cultural resource surveys and testing of recorded sites potentially affected by the Cooper Lake and Channels project were conducted in 1970-72, 1973, 1974, and 1975 under funding by the National Park Service, and in 1976 under funding by the Corps of Engineers. Based on information obtained during these investigations a determination of eligibility was received from the keeper of the National Register for the Cooper Lake Archeological District on 17 November 1977. Agreement was reached with the State Historic Preservation Officer on 24 February 1978 that previous cultural resource work conducted in the Cooper Lake area was adequate to mitigate resources affected by the project. On May 31, 1978, the Advisory Council on Historic Preservation replied to a determination by the Corps of No Adverse effect on the Cooper Lake Archeological District, and had no further comment to make on the project. No further cultural resource mitigation on known sites in the Cooper Lake area is deemed necessary at this time. The Corps of Engineers has agreed to publish a popular summary of the cultural resources in this area to make the results of previous investigations known to the general public.

Should additional cultural resources be identified upon resumption of construction of the proposed project or alternatives, these resources will be evaluated in accordance with Procedures for the Protection of Historic and Cultural Properties (36CFR800), and appropriate measures will be taken to mitigate adverse effects to those properties which may be determined eligible for inclusion in the National Register, including coordination with appropriate State and Federal agencies.

4.07 Energy Resources. The major mineral resources in the Sulphur River area are petroleum and associated products. There are about 25 to 30 producing oil and gas fields in the drainage basin, mostly localized along the Luling-Mexia-Talco fault zone which parallels the South Sulphur and Sulphur River on the south in Hunt, Hopkins, Franklin, Titus, and Morris Counties. In the vicinity of Cooper Lake, almost all of the production has been in the southeast portion of Hopkins County, though

recently there has been a well drilled (now in operation) on the southwest side of the lands acquired for the lake. Mineral rights were retained by the landowner on most lands acquired for the reservoir. Some thin seams of lignite coal, usually found in Wilcox deposits, may occur in the eastern portion of the drainage area, but generally have received little commercial interest to date except in the vicinity of Mt. Pleasant.

4.08 Prime and Unique Farmland. Under the status quo condition, there are 12,300 acres of semi-wooded land, 18,900 acres of cleared land and 58,000 acres of wooded land in the 30-year flood plain under consideration. Land inventory and Monitoring Memorandum TX-2, dated January 31, 1977, by the Soil Conservation Service, Temple, Texas, defines prime farm land as land best suited and available for producing food, feed, fiber, and oilseed crops. Prime farmland has the soil quality, growing season, and moisture supply needed to produce substained high yields of crops economically when treated or managed, including water management, according to modern farming methods. The criteria for prime farmlands do not limit the classification to those lands currently farmed. Land cover may be in pastureland, rangeland, forest, or other uses (except urban or water areas larger than 10 acres). Prime farmland may also be flooded (less often than once in 2 years) during the growing season of crops commonly grown in the county.

Based on the present use of some flood plain land for crop production, the type of soils in the flood plain (Trinity and Kaufman clays), production estimates for those soils, and the capability class (class II), almost all of the protected Sulphur River bottomlands could be considered prime farmlands. In addition, the level, productive bottomland soils in several areas of the flood plain have been used for rice production, and there is an apparent trend to an increase in production of this crop. Memorandum TX-2 lists rice as a specialty crop useful in identifying for unique farmland. Unique farmland is land other than prime farmland that is used for production of high value food and fiber specialty crops and has the special combination of soil quality, location, growing season, and moisture supply needed to produce those crops when treated or managed by modern farming methods. Much of the bottomland considered as prime farmland also has the qualities which make these lands suitable for rice production, subject to availability of storage for water to flood the fields during the 100-110 day growing season.

4.09 Land Use. Overall land use and land use trends within a study area are generally the driving factor for the economic and environmental conditions existing in that area. Within the 30-year frequency flood plain of the Sulphur River under consideration in this study and in the 1974 status quo condition, there are about 91,200 acres of land. About 58,000 acres remain wooded and are used for limited grazing, private recreational purposes such as fishing and hunting, and for selective timber harvest. About 31,200 acres are cleared or semi-cleared agricultural lands, primarily used for grazing. Outside of the 30-year flood plain, but within

the 12 counties encompassing the flood plain, land use is primarily rural and agriculturally based, with farming, cattle production, timber production, and dairy farming the principal land use activities.

Land use control or management of land use resources is not a Federal responsibility except indirectly through such legislation as the Flood Insurance Act, the Clean Water Act, and the Clean Air Act. Programs developed pursuant to this legislation may indirectly regulate use of flood plain lands, wetlands, or some industrial uses through permitting requirements, public interest reviews, or the NEPA process. Land use control, zoning, or management at the State or local level is an authority retained by these levels of government for various activities. While these authorities may exist, for practical purposes, rural land use direction or control by local or State governments in the 12 county area has little effect on land use or land use changes.

4.10 Environmental Quality (Air, Water, Noise, Esthetics). The development of national policies and legislative history to build or restore a quality environment is extensive. The Clean Water Act sets national goals for restoration of water quality and avoidance of degradation of existing water quality through positive Federal programs. The Clean Air Act sets policy for compliance of Federal projects with air quality standards. The Noise Control Act, Toxic Substances Act, Resource Conservation and Recovery Act, and the National Environmental Policy Act also express the National Policy for coequal objectives of National Economic Development and Environmental Quality.

The Sulphur River Basin is primarily rural, agriculturally oriented, and esthetic values are reflective of well-developed agricultural land (crops, grazing) in the upper basin, and dairy farming, grazing, and woodlands with timber production in the lower basin. Air quality is excellent over the region and noise levels low and generally compatible with the rural environment.

Water quality and pollutant discharge data for the South Sulphur River and the Sulphur River through 1960-1968 from USGS gaging stations and other sources were reported in the final EIS in Section II and appendix G. Data for water quality in Wright Patman Lake and 1974-1976 surface water/sediment/elutriate data for Corps of Engineers sampling sites along the Sulphur and South Sulphur Rivers were also included in appendix G of the final EIS. The South Sulphur River will be the major tributary to Cooper Lake. To evaluate ongoing changes in the quality of water, additional available USGS data for water years (WY) 1974-1978 were obtained for the gage near Cooper, Texas, on the South Sulphur River. For the parameters sampled by USGS none exceeded State or Federal criteria. The parameters sampled closely correlate to the parameters sampled on the South Sulphur River near Cooper, Texas, and included in the 1977 final EIS. Of the 13 corresponding parameters,

yearly averages exceeded the range set by the data between 1960-1968 four times, all of which were in WY 1976, a dry year. Pesticide levels for 1968 listed in table G-3 (appendix G, final EIS) were checked against USGS data for 1976-1978 for the Talco gage. The only pesticides in Sulphur River water at detectable levels in these new data were DDE, DDT, and Diazinon (0.01, 0.02, and 0.01 ug/l, respectively) on one sample date in 1978 with a 1,580 cfs discharge; Diazinon, 2, 4-D, and 2, 4, 5-T (0.01, 0.07, and 0.01 ug/l, respectively) on one sample date in 1977 with a 20 cfs discharge; and 2, 4, 5-T (0.01 ug/l) on one sample date in 1977, with a 2 cfs discharge. Water in the South Sulphur and Sulphur Rivers is suited for all known uses and purposes.

4.11 Social Resources. The people living in the 12 county area including or adjoining the Sulphur River flood plain are an important basin resource. This area is primarily agriculturally oriented, and the majority of communities within the region are small and rural oriented. The Sulphur River watershed and associated natural and man-made or man-developed resources and economy are important in maintaining and improving the living standards and life's amenities for people within this region. Anything which displaces people or farms, affects employment or population, significantly alters the land use adversely or beneficially or commits resources to resolution of water related problems and needs (flood damage reduction, water supply, recreation, fish, and wildlife) is of interest to the human resource living here. The long-term enhancement of this social resource, including both people and the man-made environment they created and function under, requires provisions for dependable water supplies, maintenance, or improvement of the regional economy, recreational opportunities including fishing and hunting, and largely intangible factors such as community cohesion, educational opportunity, health, and safety. In addition to the human resources living in the Sulphur River Basin who are more locally oriented, the study area under consideration for the Cooper Lake and Channels Project includes, in part, the human resources of a much larger area. These are the out-of-basin population who require water supply for support of regional growth and economy and are within the market area for water resource oriented recreation which could be supplied within the Sulphur River Basin. This includes the service area for local water supply sponsors (North Texas Municipal Water District, city of Irving, Texas, and the Sulphur River Municipal Water District) and part of the Dallas metropolitan area.

SECTION V - ENVIRONMENTAL EFFECTS

SECTION V - ENVIRONMENTAL EFFECTS

5.01. Introduction. The final EIS filed 24 June 1977 addressed the probable impacts of the Reservoir and Levees (recommended) alternative in Section IV, pages 1-38, and the adverse impacts which could not be avoided in Section V, pages 1-5. Impacts of the other 22 alternatives considered in the final EIS (including status quo) were addressed in Section VI, pages 1-41. A summary of the expected significant impacts of the Reservoir and Levees alternative, the Reservoir Only alternative, and the status quo, or No Action alternative are included in this section of the supplemental EIS. Impacts of the Water Supply Only alternative and the comprehensive Nonstructural alternative developed in response to the Memorandum Opinion are displayed with these plans. Data on impacts of the 22 alternatives considered previously in the final EIS are incorporated by reference in this supplemental EIS.

Table V-1 displays direct and indirect impacts of these alternatives in comparative form for resources identified as significant in Section IV. The significance of impacts to environmental, economic, and social resources is primarily related to quantification of direct and indirect land use changes correspondingly affect economic outputs and natural and cultural resources such as wetlands, wildlife and fish habitat, archeological sites, and prime farmland. The trade-offs made between economic output and natural and cultural resources affect social (people) resources related to regional growth, economic stability, health, safety, recreation, and other factors.

5.02. Reservoir and Levees Alternative (Recommended in Final EIS).

a. Beneficial Impacts:

1. Reservoir. The flood storage space in the reservoir will provide flood protection for 12,900 acres of land below the damsite. The flood storage space in Cooper Lake will also allow the future conversion of 120,000 acre-feet of existing flood storage in Wright Patman Lake (formerly Lake Texarkana) to water supply. Cooper Lake will provide 273,000 acre-feet of storage space for municipal and industrial water supply. Participation in outdoor recreation activities by Sulphur River basin residents has been quite limited in the past, due primarily to the lack of suitable areas and facilities. The reservoir and related recreation facilities will provide the needed resources and development for many types of outdoor recreation. The lake will provide about 933,200 recreation days of fishing and general recreation use. In addition, the lake is capable of supporting an annual harvest of 64,720 pounds of commercial fish valued at $9,700. About 10,000 acres of perimeter project lands would be managed for multiple uses of fish, wildlife, recreation, and flood storage.

2. Levees and channels. The levees feature of this plan will provide flood protection for 11,400 acres of land along the South Sulphur and Sulphur Rivers, for floods having a recurrence interval of once every 30 years. Construction of the remaining channels will create 16 miles of oxbow cutoffs. Modified areas, in the form of levees or disposal areas for excavated material from channel construction should

TABLE V-1

ENVIRONMENTAL EFFECTS ON
SIGNIFICANT RESOURCES

	RESERVOIR & LEVEES (FINAL EIS RECOMMENDED PLAN)	RESERVOIR ONLY (FINAL SEIS RECOMMENDED PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO PROJECTED)
DIRECT EFFECTS					
1)Endangered Species	No significant effect	No significant effect	No significant effect	No significant effect	No significant effect
2)Fish & Wildlife	19,305 acres of terrestrial habitat and 21 miles of the South Sulphur River would be inundated by the lake. An additional 3435 acres of terrestrial habitat would be partially cleared and infrequently inundated with flood pool operation. Borrow areas, outlet channel, and the dam and spillway would result in a loss of an additional 920 acres. Initial and ultimate use of seven recreation areas would limit consumptive use of wildlife resources on 3300 acres of project lands, almost all above the flood pool, but would preserve or enhance wildlife habitat on the majority of these lands. About 3,040 acres of land above the flood pool but within the fee take line, and 1540 acres of flood pool lands infrequently inundated (above the 5 year pool) would improve in quality as wildlife habitat. Inundation of stream habitat will cause the diversity of fish species within the affected reach to decrease, but lake populations of about 25% of the species now occurring in the river will increase significantly. The lake is expected to supply 192,200 man days of sport fishing, and have the potential to support an average annual harvest of 65,000 pounds of commercial fish.	19,305 acres of terrestrial habitat and 21 miles of the South Sulphur River would be inundated by the lake. An additional 3435 acres of terrestrial habitat would be partially cleared and infrequently inundated with flood pool operation. Borrow areas, outlet channel, and the dam and spillway would result in a loss of an additional 920 acres. Initial and ultimate use of seven recreation areas would limit consumptive use of wildlife resources on 3300 acres of project lands, almost all above the flood pool, but would preserve or enhance wildlife habitat on the majority of these lands. About 3,040 acres of land above the flood pool but within the fee take line, and 1540 acres of flood pool lands infrequently inundated (above the 5 year pool) would improve in quality as wildlife habitat. Inundation of stream habitat will cause the diversity of fish species within the affected reach to decrease, but lake populations of about 25% of the species now occurring in the river will increase significantly. The lake is expected to supply 192,200 man days of sport fishing, and have the potential to support an average annual harvest of 65,000 pounds of commercial fish.	19,305 acres of terrestrial habitat and 21 miles of the South Sulphur River would be inundated by the lake. Borrow areas, outlet works, and the dam and spillway would result in a loss of an additional 920 acres. Wildlife habitat on the remaining 1750 acres of project lands would be generally preserved or improved, though some perimeter clearing would be done above the water supply pool. Inundation of stream habitat will cause the diversity of fish species within the affected reach to decrease, but lake populations of about 25% of the species now occurring in the river will increase significantly. the lake is expected to support 192,200 man days of sport fishing annually, and have the potential to support an annual harvest of 65,000 pounds of commercial fish.	If private landowners were to implement the suggested land use plan, about 66,200 acres of wooded, semiwooded, and cleared terrestrial wildlife habitat in the 3 year flood plain would improve in value. Between the 3 year and 30 year flood plains, 2400 acres of semi-wooded habitat would be converted to a lower wildlife value (hay cropping) over a transition period of 10 years. 3200 acres of wooded land in this zone would be managed for timber production with potential adverse affect on wildlife values, and 12,900 acres of cleared land would retain about the same habitat value, though 80% would be more intensively used for hay cropping rather than pasture. Wooded land within the 24,200 acre corridor if acquired by a public agency, would increase in habitat value.	Habitat in the flood plain is expected to remain essentially the same in quality and quantity. Existing wooded areas average about 68% of their potential quality, semiwooded 48%, and openland 34%. The status quo flood plain contains 58,000 acres of wooded habitat, 12,300 acres of semiwooded habitat, about 18,900 acres of cleared habitat, and 2000 acres of non-agricultural land.
	The levees would directly impact a total of 800 acres of terrestrial wildlife habitat which would be converted to rights-of-way for levees, channels, disposal areas, and drainage facilities. About 600 acres of this is wooded land which would be cleared. About 16 miles of natural stream would be bypassed by new channel construction and would become oxbow lakes, but their productivity may be limited due to a lack of periodic overflow flooding.	Levee 4RSS spur required downstream from the dam would impact 5.5 acres of terrestrial habitat all of which is open land.			
3)Wetlands	The dam and other construction features would impact about 80 acres identified as wetlands. The reservoir would inundate about 5,900 acres of bottomland hardwoods, as much as 80% which would meet criteria for wetlands. However, the quantity and quality of wetland increases with downstream progression in the South Sulphur and Sulphur Rivers, and wetlands directly impacted by the reservoir are less important than those farther downstream for wildlife habitat.	The dam and other construction features would impact about 80 acres identified as wetlands. The reservoir would inundate about 5,900 acres of bottomland hardwoods, as much as 80% which would meet criteria for wetlands. However, the quantity and quality of wetland increases with downstream progression in the South Sulphur and Sulphur Rivers, and wetlands directly impacted by the reservoir are less important than those farther downstream for wildlife habitat.	The dam and other construction features would impact about 80 acres identified as wetlands. The reservoir would inundate about 5,900 acres of bottomland hardwoods, as much as 80% of which would meet criteria for wetlands. However, the quantity and quality of wetlands increases with downstream progression in the South Sulphur and Sulphur Rivers, and wetland directly impacted by the reservoir are less important than those farther downstream for wildlife habitat.	If the public corridor were acquired, about 24,200 acres of wooded overflow wetlands with associated oxbow lakes would be placed in public ownership. Values on the remainder of wetlands within the 3 year flood plain would improve slightly with removal of grazing.	An estimated 46,400 acres of wooded wetland areas within the flood plain are expected to remain essentially the same, though they are subject to private use and development of timber resources or agricultural potential depending on the economic climate in effect at any given time.

	RESERVOIR & LEVEES (FINAL EIS RECOMMENDED PLAN)	RESERVOIR ONLY (FINAL SEIS RECOMMENDED PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO PROJECTED)
	The levees would directly adversely impact about 347 acres of wetlands, and disposal of material from channel excavation not used in levees would cause the loss of an additional 140 acres. Most if not all of the remaining right-of-way used for channels and drainageways (313 acres) is also wetlands. The quality of wetland areas disturbed by levee construction increases progressively downstream.	Levee spur 4RSS affects no wetlands.			
4)Cultural Resourc	Surveys conducted in the Cooper Lake area have identified 110 prehistoric sites, about 90 of which would be affected by the water supply pool or construction areas. Testing of sites conducted between 1970-76 resulted in a determination of eligibility to the National Register of the Cooper Lake Archeological District. The testing of several known sites was determined to mitigate adequately for the loss of the remaining known sites caused by reservoir construction, and a determination of no adverse affect on the District was received from the Advisory Council on Historic Preservation on 31 May 1978. Information which may be within untested sites (known or unknown) remaining within affected areas will be lost, and sites unaffected but within acquisition lines will be placed in Federal ownership. The downstream levees as presently aligned will affect one known archeological site, which has undetermined significance. This site would require testing to determine its extent and significance prior to construction, and would be either avoided or mitigated as necessary if determined eligible.	Surveys conducted in the Cooper Lake area have identified 110 prehistoric sites, about 90 of which would be affected by the water supply pool or construction areas. Testing of sites conducted between 1970-76 resulted in a determination of eligibility to the National Register of the Cooper Lake Archeological District. The testing of several known sites was determined to mitigate adequately for the loss of the remaining known sites caused by reservoir construction, and a determination of no adverse affect on the District was received from the Advisory Council on Historic Preservation on 31 May 1978. Information which may be within untested sites (known or unknown) remaining within affected areas will be lost, and sites unaffected but within acquisition lines will be placed in Federal ownership.	Surveys conducted in the Cooper Lake area have identified 110 prehistoric sites, about 90 of which would be affected by the water supply pool or construction areas. Testing of sites conducted between 1970-76 resulted in a determination of eligibility to the National Register of the Cooper Lake Archeological District. The testing of several known sites was determined to mitigate adequately for the loss of the remaining known sites caused by reservoir construction, and a determination of no adverse affect on the District was received from the Advisory Council on Historic Preservation on 31 May 1978. Information which may be within untested sites (known or unknown) remaining within affected areas will be lost, and sites unaffected but within acquisition lines will be placed in public ownership.	Existing archeological sites within the flood plain would not be affected as a result of this alternative. The vast majority of identified sites would remain in private ownership. Any sites within the 24,200 acre corridor would become publicly owned, but no mitigation by salvage of data would be required since no adverse effect is anticipated.	At least 140 identified archeological sites in the Cooper Lake Archeological District and downstream Sulphur River flood plain would remain in private ownership. Exploitation of known sites could occur at the discretion of the landowner.
5)Energy resources	One operating oil well would be affected by Cooper Lake.	One operating oil well would be affected by Cooper Lake.	One operating oil well would be affected by Cooper Lake.	No significant effect.	No significant effect.
6)Prime farmland, agricultural activity	About 20,800 acres of existing agricultural land required for the reservoir right-of-way will be taken out of production. Most of this acreage is in cleared or semi-cleared pasture usage. 13,400 acres of agricultural land will be inundated by the water supply pool and lost. The remainder will be preserved but not used primarily for agricultrue. Most of the land within the water supply pool, including 5,905 acres of wooded bottomlands, has the potential to be considered prime farmland with control of flood hazard.	About 20,800 acres of existing agreicultrual land required for the reservoir right-of-way will be taken out of production. Most of this acreage is in cleared or semi-cleared pasture usage. 13,400 acres of agricultural land will be inundated by the water supply pool and lost. The remainder will be preserved but not used primarily for agriculture. Most of the land within the water supply pool, including 5,905 acres of wooded bottomlands, has the potential to be considered prime farmland with control of flood hazard.	About 15,300 acres of existing agricultural land needed for the reservoir right of way will be taken out of production. Most of this acreage is in cleared or semi-cleared pasture usage. 13,400 acres of agricultural land will be inundated by the water supply pool and lost. The remainder will be preserved but not used primarily for agricultrue. Most of the land within the water supply pool, including 5,905 acres of wooded bottomlands, has the potential to be considered prime farmland with control of flood hazard.	About 9,900 acres of semi-wooded and cleared pasture within the 3-year flood plain would gradually revert to wooded area if all landowners were to forgo use of this frequently flooded zone for cattle raising purposes. Higher profits with lower flood damage risk would be achieved on 19,100 acres of developed land between the 3-year and 30-year flood plains, if 80% of the semi-wooded and cleared land in this zone was converted by the landowners to hay cropping from pasture uses. All land in the flood plain would remain potential prime farmland. Acquisition of the 24,200 acre public recreation/habitat zone within the 3-year flood plain would preclude future agricultural uses of these lands, though it is now almost entirely wooded.	The majority of the land in the 91,200 acre flood plain area will remain subject to frequent flooding, and will not be available for crop or pasture uses though soils are highly productive. About 31,200 acres of developed pasture and agricultural land, some partially protected to varying degrees by levees and channels, will continue in agriculture use, but will suffer periodic flood damages.

	RESERVOIR & LEVEES (FINAL EIS RECOMMENDED PLAN)	RESERVOIR ONLY (FINAL SEIS RECOMMENDED PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO PROJECTED)
	The levees would directly effect 800 acres of land needed for right-of-way, about 200 acres of which are now in pasture use (semiwooded or cleared). With control of the flood hazard all 800 acres would be considered prime farmland.				
7)Land use	About 19,305 acres of land will be permanently converted to water storage for water supply. There will be 920 acres converted to structures needed for the dam and spillway features, and 3,435 acres used for periodic flood storage in the 30 year storage flood pool. This land, plus 3,300 acres in recreation areas, and 3,040 acres within the guide taking line will be managed for multiple purposes of recreation, erosion control and wildlife habitat management. Agricultural use on this land will be terminated with the exception of that used in conjunction with wildlife management purposes. The 800 acres needed for the downstream work will be converted from wildlife habitat and agricultural use to structures, disposal areas, channels, and drainageways.	About 19,305 acres of land will be permanently converted to water storage for water supply. There will be 920 acres converted to structures needed for the dam and spillway features, and 3,435 acres used for periodic flood storage in the 30 year storage flood pool. This land, plus 3,300 acres in recreation areas, and 3,040 acres within the guide taking line will be managed for multiple purposes of recreation, erosion control and wildlife habitat management. Agricultural use on this land will be terminated with the exception of that used in conjunction with wildlife management purposes.	About 19,305 acres of land will be permanently converted to water storage for water supply. There will be 920 acres converted to structures needed for the dam and spillway features. The remainder of land within the equistion line (1750 acres) would be used at the discretion of the local sponsors for agriculture, shoreline development, recreation, or other related purposes.	Land use would remain generally the same as the no action alternative. Conversions from pasture to hay cropping would occur on 80% of the developed flood plain lands, and wooded lands would be managed more intensively for timber production above the 3-year flood plain. The 24,200 acre wooded corridor would be public property, rather than private, if acquired by a public agency.	Overall land use within the Sulphur River flood plain would remain about the same. Agricultural activity would continue to predominate, with cattle raising and dairy farming the main activity on cleared and semi-wooded flood plain lands. Some conversions from wooded land to pasture are expected on an individual basis, while neglect of some existing levees will result in a less intensive land use on some developed lands.
8)Environmental quality, pollution of air and water, noise, esthetics	A temporary degradation of air and water quality will occur during construction, and existing rural esthetic value will be replaced by a levee and channeled flood plain in directly impacted areas and a 19,305 acre lake. Construction activity will also increase noise temporarily in the rural area. After initial effects of construction and filling of the water supply poo', a new esthetic resource of a different qulity will be in place. Natural esthetic value should improve rapidly on perimeter lands around the lake. An increase in recreation noise is expected. Water quality in the lake should be suitable for all known uses.	A temporary degradation of air and water quality will occur during construction, and existing rural esthetic value will be replaced by a 19,305 acre lake. Construction activity will also increase noise temporarily in the rural area. After initial effects of construction and filling of the water supply pool, a new esthetic resource of a different quality will be in place. Natural esthetic value should improve rapidly on perimeter lands around the lake. An increase in recreation noise is expected. Water quality in the lake should be suitable for all known uses.	A temporary degradation of air and water quality will occur during construction, and existing rural esthetic value will be replaced by a 19,305 acre lake. Construction activity will also increase noise temporarily in the rural area. After initial effects of construction an filling of the water supply pool, a new esthetic resource of a different quality will be in place. Natural esthetic value should improve rapidly on perimeter lands around the lake. An increase in recreation noise is expected. Water quality in the lake should be suitable for all known uses.	There would be no significant quantifiable direct effects on air and water quality. An increase in recreation noise is expected at access areas. A slight improvement in esthetic value is expected on 24,200 acres of public corridor lands.	The rural environment would continue to promote a reasonable level of environmental quality for its human inhabitats. Air quality and noise pollution should not become significant problems, and esthetic value will reflect a rural/agriculture based way of life. Water quality in streams will be largely controlled by existing laws on point source discharges and farm management practices.

	RESERVOIR & LEVEES (FINAL EIS RECOMMENDED PLAN)	RESERVOIR ONLY (RECOMMENDED FINAL SEIS PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO PROJECTED)
9) Social-economic	There will be nine families (estimated 21 people) displaced. Recreation opportunity provided in two parks initially developed by the Corps and on project land and water would provide 933,200 man-days of annual consumptive and non-consumptive use for the market area. Open space and future recreational value would be preserved on 3300 acres of designated recreation lands, and 6,475 acres of other perimeter lands used for multiple purposes. With the exception of restroom facilities which may be located somewhat higher, recreation facilities generally would be placed near the 5 year flood pool (elev 443.4). The two parks initially developed, however, are gently sloping and very little land is within the flood pool along the shoreline. No private shoreline development would occur. The community cohesiveness normally exhibited in rural agricultural areas will be temporarily disrupted due to displacement of farm families, however, this will not be a lasting impact as tendencies for farm families are generally to settle within the same area.	There will be nine families (estimated 21 people) displaced. Recreation opportunity provided in two parks initially developed by the Corps and on project land and water would provide 933,200 man-days of annual consumptive and non-consumptive use for the market area. Open space and future recreational value would be preserved on 3300 acres of designated recreation land., and 6,475 acres of other perimeter lands used for multiple purposes. With the exception of restroom facilities which may be located somewhat higher, recreation facilities generally would be placed near the 5 year flood pool (elev 443.4). The two parks initially developed, however, are gently sloping and very little land is within the flood pool along the shoreline. No private shoreline development would occur. The community cohesiveness normally exhibited in rural agricultural areas will be temporarily disrupted due to displacement of farm families, however, this will not be a lasting impact as tendencies for farm families are generally to settle within the same area.	There will be nine families (estimated 21 people) displaced. Recreation opportunity expected to be provided by the local sponsors or other entities would provide 275,000 man-days of annual consumptive and non-consumptive use for tah market area. Open space would be preserved on about 1,750 acres of perimeter lands. Shoreline development may occur at the option of the local sponsors which could provide waterfront access to a number of second-home or retirement-home developments expected to occur around the lake. Recreation facilities provided would generally be constructed above free board required for fluctuations above the water supply pool. Community cohesion would be interrupted temporarily due to displacement of families. Impacts will not be permanent, as rural families tend to relocate within the same area.	No families would be diplaced. Two houses would be flood proofed to reduce flood risk and damage. Potential recreation demand satisfied on land within the corridor would total 542,000 man-days if lands were acquired, operated, and maintained by a Federal, State or local sponsor. Community cohesion will not be affected.	The rural-economic/social balance now in existence would be maintained. Existing developed agricultural lands in the flood plain would continue to provide eonomic support for the landowners, but would also continue to suffer flood damage with loss of potential income to the landowner. Uncoordinated private actions to maintain, restore, or decrease flood risk to developed lands by increasing heights or extending existing levees as private economic incentives for flood plain utilization warrant.

INDIRECT EFFECTS	RESERVOIR & LEVEES (RECOMMENDED FINAL EIS PLAN)	RESERVOIR ONLY (RECOMMENDED FINAL SEIS PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO PROJECTED)
1)Endangered species	No significant impact.	No significant impact.	No significant impact.	No significant impact.	No significant impact.
2)Fish and wildlife	The reservoir would provide protection to 3,200 acres of wooded land, 1,500 acres of semi-wooded land, and 8,200 acres of cleared land. Intensification of 80% of the wooded land and all of the semi-wooded land is predicted resulting in a loss of 2,560 acres of wooded wildlife habitat and 1,500 acres of semi-wooded habitat over a period of 10 years. Regulation of the downstream water releases from the dam would change the fishery composition in the South Sulphur and Sulphur Rivers. The levees and channels would provide protection to 8,700 acres of wooded land, 1,800 acres of semi-wooded, and 900 acres of cleared land. Intensification of this land will result in a loss of 6,960 acres of wooded wildlife habitat, and 1,800 acres of semi-wooded habitat.	The reservoir would provide protection to 3,200 acres of wooded land, 1,500 acres of semi-wooded land, and 8,200 acres of cleared land. Intensification of 80% of the wooded land and all of the semi-wooded land is predicted resulting in a loss of 2,560 acres of wooded wildlife habitat and 1,500 acres of semi-wooded habitat over a period of 10 years. Regulation of the downstream water releases from the dam would change the fishery composition in the South Sulphur and Sulphur Rivers.	The only indirect effects on downstream fish and wildlife would be related to a possible perceived decrease in flooding risk by flood plain landowners with the water supply dam in place. In actuality, there may be a slightly decreased flood risk during years in which the water supply pool is low prior to flood periods, but in most years, all flood waters would be passed thru the spillway keeping flood impacts to downstream lands essentially the same as no action. The degree to which the perceived decrease in flood risk would result in clearing of wildlife habitat downstream is therefore not quantified. There would be slight change in downstream fisheries due to effects of water supply use upstream, but flood flows and normal releases would remain generally the same.	Indirect impacts are the same as direct impacts due to the voluntary nature of the land use zoning plan.	Fish and wildlife resources would continue in the status quo condition in balance with the habitat which now supports them. The quality of most habitat within the flood plain and adjoining areas is substantially below the level of its potential to support fish and wildlife resources. Demand for utilization of fish and wildlife resources through sport hunting and fishing will remain high, and access to hunting land or stream resources will continue to restrain the potential of the habitat to meet demands.
3)Wetlands	It is estimated that 80% of the wooded area protected by the reservoir meets criteria for classification as wetlands. Protection from annual flooding, and intensification of land use over a 10 year period will result in the loss of about 2,048 acres of wetlands. Periodic flood pool releases at 3,000 cfs will result in an average wetter environment on 641 acres of downstream land inundated longer durations than under natural conditions. This will be partially offset by consumptive water losses and refilling the water supply pool during minor floods. The levees and channels protect about 7,616 acres of wetlands from annual flooding. Lack of flooding and intensification will result in a loss of all of this wetland acreage over a 10 year period.	It is estimated that 80% of the wooded area protected by the reservoir meets criteria for classification as wetlands. Protection from annual flooding, and intensification of land use over a 10 year period will result in the loss of about 2,048 acres of wetlands. Periodic flood pool releases at 3,000 cfs will result in an average wetter environment on 641 acres of downstream land inundated longer durations than under natural conditions. This will be partially offset by consumptive water losses and refilling the water supply pool during minor floods.	Downstream wetlands areas shoul remain periodically flooded in most years with operation of the water supply only project. Consumptive use of water and periodic replenishment of the water supply pool during minor floods will result in a somewhat drier average environment on downstream low elevation wetlands.	An estimated 46,400 acres of wooded wetland within the 3 year flood plain would gradually improve in value over time.	Wetland areas in the flood plain and outside the flood plain would remain essentially the same, though subject to private development when the proper economic incentives exist.
4)Cultural resources	Archeological sites on lands indirectly impacted by protection from flooding would no longer be periodically inundated (with 30-year protection). Land conversions to pasture use on protected lands should benefit, or at least not adversely impact archeological sites in protected areas. Sites would remain in private ownership.	Archeological sites on lands indirectly impacted by protection from flooding would no longer be periodically inundated (with 30-year protection). Land conversions to pasture use on protected lands should benefit, or at least not adversely impact archeological sites in protected areas. Sites would remain in private ownership.	No significant indirect impacts (beneficial or adverse) are expected on downstream lands.	No significant indirect impact	No significant indirect impact.
5)Energy resources	Future recovery of oil within project lands would be slightly more expensive to the holder of mineral rights.	Future recovery of oil within project lands would be slightly more expensive to the holder of mineral rights.	Future recovery of oil within project lands would be slightly more expensive to the holder of mineral rights.	No significant impact	All energy resources would remain subject to private exploitation and public controls (permits, etc.).

	RESERVOIR & LEVEES (RECOMMENDED FINAL EIS PLAN)	RESERVOIR ONLY (FINAL SEIS RECOMMENDED PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO PROJECTED)
6) Prime farmland, agricultural activity	With protection from frequent flooding, about 12,900 acres of private flood plain lands, most of which is considered prime farmland, would be utilized at a higher level. Hay cropping is expected on suitable lands, with conversion of remaining semi-wooded and 80% of protected wooded lands to pasture use. An additional 11,400 acres of land in the flood plain would be protected by levees from frequent flooding, allowing use of most of this acreage for pasture and hay cropping.	With protection from frequent flooding, about 12,900 acres of private flood plain lands, most of which is considered prime farmland, would be utilized at a higher level. Hay cropping is expected on suitable lands, with conversion of remaining semi-wooded and 80% of protected wooded lands to pasture use.	The only indirect impacts on prime farmland would be those related to general private land use conversions on farm lands adjacent to the water supply reservoir (subdivisions, business, recreation).	There would be no indirect impacts on prime farmland or agricultural activity except those associated with voluntary changes in crop production on lands between the 3 and 30 year flood plain.	No indirect impacts are expected on prime farmaind or agricultural activity. The current agriculatural base of both flood plain and non-flood plain lands within the study area would be maintained and subject to flood risk, weather conditions, and other factors.
7) Land use	Land use would be enhanced on a total of 24,300 acres of downstream protected lands. Lands adjacent to the reservoir would be expected to undergo long-term development into second homes, and small business or commercial enterprizes supported by development of the lake for recreation.	Land use would be enhanced on a total of 12,900 acres of downstream protected lands. Lands adjacent to the reservoir would be expected to undergo long-term development into second homes, and small business or commercial enterprizes supported by development of the lake for recreation.	Lands adjacent to the reservoir would be expected to undergo long term development into second homes, and small business or commercial enterprizes supported by development of the lake for recreation.	Limited enhancement of land value adjacent to recreation areas is expected to occur, and enterprizes supported by recreation use of the public lands are expected to develop along access roads at river crossings. Major land use changes will not occur, however,	Land use is expected to remain primarily agriculturally oriented over the entire study area. Minor local land use changes will occur adjascent to cities, towns, and communities in accordance with normal progression of time and economic incentives.
8) Environmental quality, pollution of air and water, noise, and esthetics	Subdivision development adjacent to the lake, and an increase in population supported in part by the lake will indirectly and incrementally contribute to air and water pollution, degradation of rural esthetic value, and natural environmental quality which would have to be regulated in part by local or state agencies. A major esthetic attraction would be created by the public surface water reservoir. Water quality would be indirectly improved in the Sulphur River downstream through trapping effects of the lake.	Subdivision development adjacent to the lake, and an increase in population supported in part by the lake will indirectly and incrementally contribute to air and water pollution, degradation of rural esthetic value, and natural environmental quality which would have to be regulated in part by local or state agencies. A major esthetic attraction would be created by the public surface water reservoir. Water quality would be indirectly improved in the Sulphur River downstream through trapping effects of the lake.	Subdivision development adjacent to the lake, and an increase in population supported in part by the lake will indirectly and incrementally contribute to air and water pollution, degradation of rural esthetic value, and natural environmental quality which would have to be regulated in part by local or state agencies. A major esthetic attraction would be created by the public surface water reservoir. Water quality would be indirectly improved in the Sulphur River downstream through trapping effects of the lake.	The quality of the natural environment and air and water resources beyond lands directly affected in the flood plain will be little changed.	Environmental quality will remain generally good, rural oriented, and subject to existing public regulatory controls and private economic development incentives.
9) Social-economic	Population is expected to increase in the local area by 26,400 persons due to construction of the proposed project. Desirable community growth will occur in the immediate area of the reservoir resulting from increased activity along the shoreline for weekend homes and peripheral business activities. This plan, with proposed mitigation, would result in a net loss of about $5.3 million in property value, a net gain of $58 million in agricultural revenue, and a net annual loss of about $19,500 in tax revenue.	Population is expected to increase in the local area by 26,400 persons due to construction of the proposed project. Desirable community growth will occur in the immediate area of the reservoir resulting from increased activity along the shoreline for weekend homes and peripheral business activities. This plan, with proposed mitigation, would result in a net loss of about $3.4 million in property value, a net gain of $28 million in agricultural revenue, and a net annual increase of about $24,600 in tax revenues.	Population is expected to increase in the local area by 26,400 persons due to construction of the proposed project. Desirable community growth will occur in the immediate area of the reservoir resulting from increased activity along the shoreline for weekend homes and peripheral business activities. This plan, with proposed mitigation, would result in a net loss of about $7.9 million in property value, no change in agricultural revenues, and a net annual decrease in tax revenues of about $22,000.	Existing trends in population changes, will continue with no specific affects attributable to the voluntary land use plan. Recreation use, if developed by a public agency, could cause some population growth. Community cohesion and community growth outside the immediate flood plain should be little affected. This plan will result in a net loss in property value of about $4.2 million, a net loss in agricultrual revenues of about $3.2 million, and a net annual loss in tax revenues of about $77,800.	Existing trends in population, recreation demand and supply will continue. Community growth and cohesion will remain the same.

OTHER EFFECTS	RESERVOIR & LEVEES (FINAL EIS RECOMMENDED PLAN)	RESERVOIR ONLY (FINAL SEIS RECOMMENDED PLAN)	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL	NO ACTION (STATUS QUO PROJECTED)
Conflicts with land use plans, policies, objectives	The plan conflicts with no known local governmental land use plans, policies, or objectives.	The plan conflicts with no known local government land use plans, policies, or objectives.	The plan conflicts with no known local governmental land use plans, policies, or objectives.	The plan conflicts with no known local governmental land use plans, policies, or objectives	
Energy requirements	Construction of the dam, levees, associated structures, and channels would require the commitment of gasoline, diesel fuel, other petroleum oils, and electric power expended during construction, and a continuing quantity of similar energy resources to operate and maintain the project features. The cost of these resources is reflected in cost estimates for construction and operation.	Construction of the dam and associated structures would require the commitment of gasoline, diesel fuel, other petroleum oils, and electric power expended during construction, and a continuing quantity of similar energy resources to operate and maintain the project features. The cost of these resources is reflected in cost estimates for construction and operation.	Construction of the dam, levees, associated structures, and channels would require the commitment of gasoline, diesel fuel, other petroleum oils, and electric power expended during construction, and a continuing quantity of similar energy resources to operate and maintain the project features. The cost of these resources is reflected in cost estimates for construction and operation.	A small amount of gasoline, diesel oil, and electric power would be committed to construction and operation of recreation facilities. The cost of these resources is reflected in cost estimates for construction and operation of the 24,200 acre corridor for recreation.	None
Natural, depletable resources conservation potential	Natural resources lost include land and associated resources required for the water supply pool and construction features. Natural resources modified include remaining project lands which would be conserved and used for multiple-purposes, and downstream wooded lands which will lose much of their value as wetlands and wildlife habitat. A new natural resource, a surface water source, will be created. Depletable resources such as fossil fuel derivatives, metals, concrete and other materials used in construction or operation will be committed to the project.	Natural resources lost include land and associated resources required for the water supply pool and construction features. Natural resources modified include remaining project lands which would be conserved and used for multiple purposes. Downstream wooded lands protected partially by the reservoir will lose much of their value as wetlands and wildlife habitat. A new natural resource, a surface water source, will be created. Depletable resources such as fossil fuels, metals, concrete, and other materials used in construction or operation will be committed to the project.	Natural resources lost include land and associated resources required for the water supply pool and construction features. A new natural resource, a surface water source will be created. Remaining project lands would be conserved. Repletable resources such as fossil fuels, metals, concrete, and other materials used in construction or operation will be committed to the project.	No significant amount of natural or depletable resources would be committed to the plan. Natural resources on the 24,200 acre corridor would be conserved.	No major change in land use is predicted which would trigger an adverse or beneficial effect on natural or depletable resources. If water supply needs were not met by other surface sources, the lack of action to provide water supply would force future rationing or conservation measures to extend existing supplies.
Cultural resources, urban quality, built environment	Satisfaction of identified water supply needs would continue to support the built environment in the water supply service areas, and contribute to amenities in the urban areas. Recreation demands identified for the region would be partially satisfied. Identified cultural resources (archeological sites) in the impacted area have been partially mitigated by data collection. Other cultural aspects of urban life quality should not be significantly affected.	Satisfaction of identified water supply needs would continue to support the built environment in the water supply service areas, and contribute to amenities in the urban areas. Recreation demands identified for the region would be partially satisfied. Identified cultural resources (archeological sites) in the impacted areas have been partially mitigated by data collection. Other cultural aspects of urban life quality should not be significantly affected.	Satisfaction of identified water supply needs would continue to support the built environment in the water supply service areas, and contribute to amenities in the urban areas. Recreation demands identified for the region would be partially satisfied. Identified cultural resources (archeological sites) in the impacted area have been partially mitigated by data collection. Other cultural aspects of urban life quality should not be significantly affected.	Partial satisfaction of identifed stream recreation needs would contribute to urban and rural life quality within the market area. Cultural resources on acquired corridor lands would be in public ownership. Other cultural aspects of urban life quality should not be significantly affected. Water supply needs would not be addressed by this alternative. Water supply would have to be provided by local interests.	Water supply needs would not be met by this study, though it is likely that other surface sources would be constructed by non-federal interests at some location within the service area, either cooperatively or individually by the water supply sponsors.
Means to mitigate adverse impacts	Based on USF&WS analysis, net adverse impacts in terrestrial habitat caused by this plan would require the acquisition and mid-level development and management of 45,788 acres of bottomland hardwoods and 10,919 acres of semi-wooded habitat for full compensation. The Corps recommended mitigation area included a total of about 48,600 acres.	Based on USF&WS analysis, net adverse impacts on terrestrial habitat caused by this plan would require the acquisition and mid-level development and management of 21,424 acres of bottomland hardwoods and 8,359 acres of semi-wooded habitat for full compensation. The Corps recommended mitigation area includes a total of 25,500 acres.	Based on USF&WS analysis, net adverse impacts in terrestrial habitat caused by this plan would require the acquisition and mid-level development and management of 19,885 acres of bottomland hardwoods and 7,723 acres of semi-wooded, and 3,925 acres of openland habitat for full compensation. The Corps recommended mitigation area includes a total of 25,500 acres.	Based on USF&WS analysis, net adverse impacts on terrestrial habitat caused by this plan would require the acquisition and mid-level management of 14,316 acres of semi-wooded habitat. However, there is an equivalent 67,717 acre surplus in botttomland hardwood habitat due to conversion of semi-wooded and openland habitat to this type within the 3-year flood plain. No mitigation is, therefore, appropriate.	None required, existing Federal and State programs would continue to operate to regulate environmental quality in so far as practicable.

provide support habitat for species which normally inhabit bottomland hardwood areas.

b. Adverse Environmental Effects.

1. Reservoir. There would be 19,305 acres of terrestrial habitat permanently inundated by the lake. All of the faunal inhabitants will be forced to relocate or die. In addition, 21 miles of the South Sulphur River above the damsite will lose all characteristics which distinguish streams from lakes due to this inundation. Although a significant increase in the population of sport and commercial fish is anticipated, about 50 percent of the species occurring in the natural streams will not benefit from the reservoir. In addition to losses directly attributable to project construction, induced clearing of 2,560 acres of bottomland hardwoods and 1,500 acres of semiwooded area would result in further adverse impact to the natural environment. Direct and indirect reservoir induced losses in sport hunting and stream fishing average 11,000 man-days with a value of about $26,000. The loss in potential for an annual harvest of 5,632 pounds of commercial stream fish valued at about $800 would result from inundation of the stream. The loss in potential for an annual harvest of commercial furbearers valued at about $1,700 would result from habitat losses. Reservoir construction will produce substantial temporary air, noise, and water pollution during the early phases of the project. Several roads and utility lines and a number of graves must be relocated. Ninety identified archeological sites will be directly affected by construction of the reservoir; however, mitigation of archeological resources in the Cooper Lake area has been accomplished by testing and evaluation of sites. Operation of the flood pool for periodic storage of floodwater will tend to adversely impact less tolerant vegetation on lands above the permanent water supply pool. The degree of loss of vegetation will be highest nearest the normal pool, to no impact at the 30-year frequency level of storage. A total of 3,435 acres of land is included in the flood pool, consisting of 893 acres of wooded land, 344 acres of semiwooded land, and 2,198 acres of open land. Periodic impacts on open land will be minimal as recovery time of vegetation between flood storage events is relatively short. Periodic inundation of wooded or semiwooded lands is expected to result in some loss of trees and also a shift to more tolerant trees over a long-term period. About 683 acres of wooded/semiwooded habitat are expected to be inundated on the average of once every 5 years, and vegetative impacts on less tolerant species on this area could be expected to be the most severe. Above the 5-year frequency flood, most woody species could tolerate periodic short-term flooding, and periodic flooding may even enhance growth rates of a number of species. The basic character of the wooded or semiwooded land would, however, remain unchanged. Periodic releases of floodwater downstream of the 3,000 cfs rate will also keep 641 acres of downstream wooded areas periodically flooded for a longer duration than would be the case under natural cyclic flood conditions. The worst expected case would be a 3,000 cfs release over a period of about 58 days occurring with storage of the 30-year frequency flood. Species now existing on these lands are wetland species tolerant to periodic flooding during the growing season. Single event historical floods have occurred within the period of record which have inundated

similar lands for as long as 86 days. Considering the species present and natural annual flooding that now occurs on these lands, it is reasonable to expect that the periodic 3,000 cfs discharge, even though longer in duration than most annual events, would cause no significant tree mortality or vegetative changes on these lands.

2. Levees and Channels. Some 800 acres of land are required for construction of the levees and channels. Terrestrial fauna and flora will be eliminated from that area occupied by the channel, while disposal of dredged material and levee construction will permanently alter the immediate terrestrial ecosystem. Construction of the channels will result in the realinement of 16 miles of natural river with a resulting loss of riparian cover, increased current velocities, increased turbidity, and a reduction in habitat diversity for aquatic fauna. Of greater significance is the potential loss of 6,960 acres of bottomland hardwoods and 1,800 acres of semiwooded area to agricultural pursuits as a result of the flood protection provided by the levees. Direct and indirect levee induced losses in sport hunting and stream fishing average 5,141 man-days annually, with a value $13,300. The loss in potential for an annual harvest of commercial furbearers valued at about $900 would result from losses in habitat. Construction of the levees and channels will produce adverse air and noise impacts during construction, and a subsequent temporary deterioration in water quality. Several bridges, pipelines, and powerlines will require relocation. This feature could adversely impact upon one identified archeological site; however, this site could probably be avoided with minor changes in the levee alinement or mitigated if future testing conducted during construction indicated significant data may be contained there.

c. Mitigation Requirements. Corps proposed terrestrial habitat mitigation for the Reservoir and Levees plan would require acquisition and management of 48,600 acres of bottomland hardwood and semiwooded habitat. This mitigation would add about $724,100 in average annual charges to this plan. Land acquisition would cause adverse economic and social impacts. Estimated tax losses for this quantity of land are $111,340, and productivity losses amount to about $4.9 million. Terrestrial habitat mitigation would offset net losses of sport huntin and potential fur harvest.

5.03. Reservoir Only Alternative (Recommended in Final Supplemental EIS.

a. Beneficial Impacts. The reservoir considered as the Reservoir Only alternative has the same specifications as the reservoir in the Reservoir and Levees alternative. Therefore, the beneficial impacts are the same as discussed in the final EIS for the reservoir feature of the final EIS recommended plan and summarized above in paragraph 5.02a. By deleting construction of all remaining authorized downstream levee and channel work, the Reservoir Only plan has the beneficial effect of not directly impacting 800 acres of land for rights-of-way and 16 miles of natural river. Induced clearing of 6,960 acres of bottomland hardwoods and 1,800 acres of semiwooded land would also be avoided as a result of the Reservoir Only alternative (as compared to the Reservoir and Levees alternative), as would downstream construction impacts on air, noise, and water quality. Under the status quo projected future, these lands

are assumed to remain in timber.

b. Adverse Environmental Impacts. Adverse environmental impacts of the Reservoir Only alternative are the same as for the reservoir feature of the Reservoir and Levees alternative summarized in paragraph 5.02b. Economic benefits of enhanced agricultural production on lands in the 30-year Sulphur River flood plain downstream of the confluence with the North Sulphur would be foregone on all lands except 600 acres.

c. Mitigation Requirements. Corps proposed terrestrial habitat mitigation for the Reservoir Only plan would require the acquisition and management of 25,500 acres of bottomland hardwood and semiwooded habitat. This mitigation would add about $403,000 in average annual charges to this plan. Land acquisition would cause adverse economic and social impacts. Estimated tax losses for this quantity of land are $58,500, and productivity losses are estimated at about $2.7 million. Terrestrial habitat mitigation would offset net losses of sport hunting and potential fur harvest.

5.04. Water Supply Only Alternative. The most likely Water Supply Only alternative is a single stage surface water source at the Cooper site. It is expected that this lake, in the absence of Federal support, would be constructed to the same specifications as the multiple purpose Cooper Lake authorized by Congress by one or more local sponsors. As is the case with most water supply lakes constructed by cities, river authorities, or water districts in Texas, it is expected that a minimal amount of land above the water supply pool would be acquired since provision for a flood pool is unnecessary. It is also assumed that recreational use would occur on the lake consisting of boat ramp and water access facilities, and minimum facilities for health and safety at two locations on land acquired by the local sponsor. There would be no Federal interest in recreation development, but it is possible that State support of some recreation development on lands acquired by the local sponsor could occur.

a. Beneficial Impacts. The lake would provide 273,000 acre-feet of storage and provide a reservoir with related recreation potential on 19,305 acres of water. Expected recreation use would average 275,000 man-days. The lake would be capable of supporting an annual harvest of 64,720 pounds of commercial fish, with a value of $9,700. About 1,750 acres of project lands above the water supply pool would be managed at the discretion of the local sponsor for fish and wildlife, shoreline development, recreation, or agriculture.

b. Adverse Impacts. There would be 19,305 acres of terrestrial habitat inundated by the lake and about 21 miles of the South Sulphur River. Populations of sport and commercial fish capable of living in reservoirs would increase dramatically in the lake, but populations of about 50 percent of the stream species now occurring in the affected area would be reduced or eliminated. Losses in sport hunting and fishing average 8,450 mandays with a value of $19,300. The loss in potential harvest of about 5,632 pounds of commercial stream fish valued at about $800 would result from stream inundation. A loss of about $1,285 annually from commercial furbearers would also result from the loss in habitat.

Reservoir construction would result in substantial temporary air, noise, and water pollution during early phases of the project. Roads, utility lines, and cemeteries must be relocated. Ninety identified archeological sites, partially mitigated through data collection, would be directly affected by the reservoir. Further mitigation would be up to the local sponsors or as required for obtaining State or Federal permits for construction.

c. Mitigation Requirements. Corps proposed terrestrial habitat mitigation for the Water Supply Only plan would require acquisition and management of 25,500 acres of bottomland hardwood, semiwooded, and open habitat. This mitigation would add about $359,100 in average annual charges to this plan. Land acquisition would cause adverse economic and social impacts. Estimated tax losses for this quantity of land are $58,500, and productivity losses amount to about $2.7 million. Terrestrial habitat mitigation would offset sport hunting losses and potential fur harvest.

5.05 Nonstructural Alternative.

a. Beneficial Impacts. About 66,200 acres of land within the 3-year flood plain would improve in value. This includes the conversion of about 9,900 acres of semiwooded and cleared pastureland to bottomland hardwoods through natural succession over the life of the project. About 24,200 acres within the public corridor, if purchased by a local sponsor, would improve in wildlife value. Public use on this land and highway access parks would provide 542,000 recreation days. Fish and wildlife benefits from a net increase of 12,000 mandays of sport hunting and fur harvest increases are about $31,700. Wetlands within the corridor would be preserved with public ownership, and a total of about 46,200 acres of wooded wetlands within the 3-year flood plain would gradually improve in value.

Overall net flood damage reduction benefits within the 30-year flood plain, if implemented by landowners, would be $183,100. This includes land use changes, reduction in fence damages, and floodproofing of two houses within the 30-year flood plain.

b. Adverse Impacts. Economic productivity would be reduced on lands within the 3-year flood plain, and 9,900 acres of cleared or semicleared lands would revert to a lower land use (wildlife habitat). About 24,200 acres of land would be removed from private ownership, agricultural production, and the local tax rolls. Wildlife values on cleared land in the 3- to 30-year flood plain would be reduced slightly due to the change to hay cropping, and 2,400 acres of semiwooded habitat would be cleared.

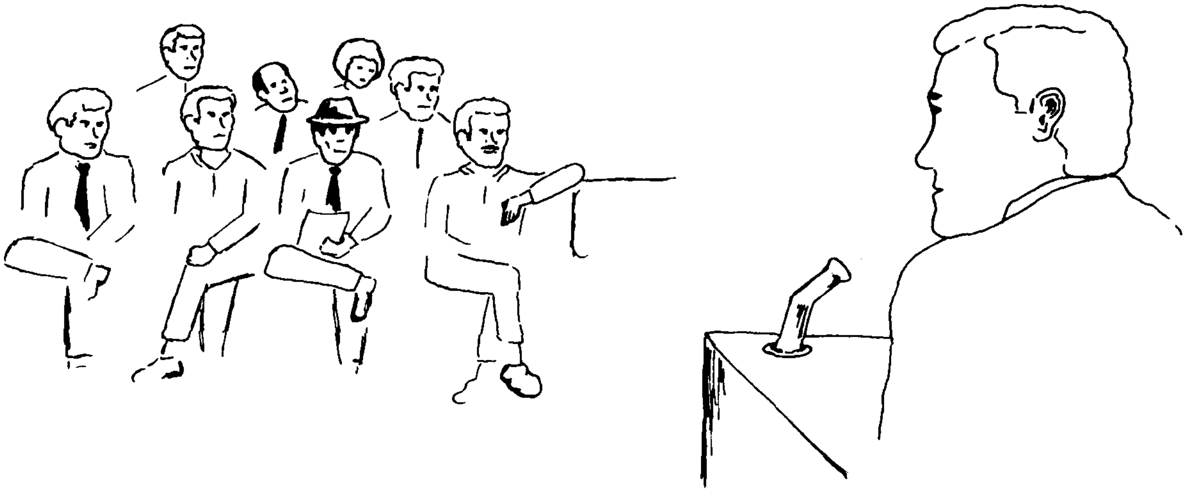
c. Mitigation Requirements. The Nonstructural plan will result in the conversion of 6,600 acres of semiwooded habitat to bottomland hardwoods and a conversion of 2,400 acres of semiwooded to open habitat. In-kind full compensation for these semiwooded losses would require acquisition and management of about 14,300 acres of semiwooded habitat. However, since the net losses of semiwooded habitat are primarily the result of conversion to a more productive habitat type

(bottomland wooded) compensation for this plan is considered inappropriate. Therefore, no mitigation charges are added to this plan.

5.06. No Action Alternatives.

a. Beneficial Impacts. Habitat in the flood plain is expected to remain essentially the same in quantity and quality. Various economic mechanisms will interact to cause clearing in some areas, while other areas will revert to lower economic land uses over time. The rural/esthetic/environmental balances now in existence will continue in the absence of major incentives to drive land use change. Lack of change or slow change, is considered a beneficial impact to wildlife habitat and other environmental considerations, and it allows time for economic and social reactions to naturally occur and adjust to each other.

b. Adverse Impacts. The majority of land in the 91,200 acre 30-year flood plain will remain subject to frequent flooding and will not be used for crop or pasture uses though soils are highly productive. About 31,200 acres of cleared and semicleared pastureland and fences, farm structures, and equipment will continue to suffer flood damage. It is expected that local interests will develop the surface water supply yield of the Sulphur River at some future date in the absence of a Federal multiple-purpose project. Based on Corps studies of the most probable Water Supply Only project, this is expected to occur at the Cooper site, though timing is uncertain. Local water supply sponsors hold water rights to the South Sulphur River water.



SECTION VI - PUBLIC INVOLVEMENT

SECTION VI - PUBLIC INVOLVEMENT AND

HISTORY OF COORDINATION

6.01 Early Planning. The early planning on the project was accomplished in response to 10 congressional committee resolutions adopted during the period April 1937 through January 1949 requesting reviews of various existing reports on projects within the Red River Basin. The planning was also accomplished in response to 11 Congressional acts adopted during the period August 1935 through July 1946 authorizing preliminary examinations and surveys within the Red River Basin. Public hearings were held during the period 1936 through 1947 at various points through the basin in order to afford local interest the opportunity to express their views and desires on the situation at hand. Seventeen public hearings were held in the upper basin above Fulton, eight in the basin below Fulton, and two were held in Washington, DC. In general, local interests desired navigation improvements, the construction of reservoirs and levees, and channel improvements for flood control and allied purposes, including major drainage, power irrigation, recreation, and municipal water supply. One major improvement desired by local interests in the basin below Denison Dam was the improvement of the Sulphur River and its Tributaries, which consisted generally of construction of Cooper Dam and Reservoir, channel improvements, and levee construction.

On 17 April 1950, the Board of Engineers for Rivers and Harbors issued a public notice describing the improvements which it proposed to recommend in its report in response to the Congressional resolutions. This afforded local interests an opportunity to present additional information and their more recent views to the board. Prior to adopting its final recommendations, the board gave careful considerations to the communication received. The board filed its report on 20 June 1950.

Advanced planning for the Cooper Lake and Channels project began in 1957, with actual construction work beginning on some levees and channels in 1958.

DRAFT EIS-FINAL EIS

6.02 Draft EIS Availability. The notice of availability of the Draft EIS was published in the *Federal Register* on 18 June 1976. A news release was issued by the office of the New Orleans District Engineer, via local newspaper, and single copies of the draft statement were made available to the public upon request. The draft EIS was mailed to Federal, State, and local Government agencies, environmental groups and organizations, and individuals known to have an interest in the project.

6.03 Public Meeting to Review Draft EIS. On 31 July 1976 a public meeting was held in Commerce, Texas, to review the draft EIS. All interested persons were urged to present pertinent factual material in support of their views concerning this document. Of the nearly 650 people in attendance at the meeting, 55 delivered oral statements. Those who

presented statements included two members of the U.S. House of Representatives, a representative of the Governor of Texas; various State senators and representatives; representatives of various State agencies, State institutions, and environmental/conservation groups; landowners; and other public interest groups. Nearly unanimous support of the total authorized plan was evidenced at the meeting. Of the 55 speakers at the meeting, three (Edward C. Fritz, Chairman of the Texas Committee on Natural Resources; Howard Saxion, Inland Conservation Chairman of the Lone Star Chapter of the Sierra Club; and Leland Wommack, resident of the Sulphur River Basin) expressed opposition to one or more features of the authorized plan.

6.04 Final EIS. Based on analysis of all written comments received on the draft EIS, and results of the public meeting, a recommended plan for the Cooper Lake and Channels was finalized and incorporated into a final EIS which was filed with CEQ on 24 July 1977. Written comments were received from the following recipients of the draft EIS and were reported in the final EIS with response by the Corps of Engineers:

a. Federal.

Advisory Council on Historic Preservation (25 June 1976)
US Department of Transportation, Federal Highway Administration (25 June 1976)
US Public Health Service, Vector-borne Disease Division (6 July 1976)
US Department of Agriculture, Forest Service (4 August 1976)
US Department of Health, Education, and Welfare, Regional Office (5 August 1976)
US Department of Commerce, Deputy Assistant Secretary for Environmental Affairs (10 August 1976)
Environmental Protection Agency (16 August 1976)
US Department of Interior, Office of the Secretary Southwest Region (17 August 1976)
Federal Power Commission (1 September 1976)

b. State.

Louisiana Department of Public Works (29 June 1976)
Arkansas Department of Local Services (30 August 1976)
(Arkansas Game and Fish Commission)
(Arkansas Historic Preservation Program)
Governor of Texas (14 December 1976)

c. Environmental Groups.

Environmental Defense Fund (29 June 1976)
Ozark Society, Bayou Chapter (29 July 1976)
Texas Committee on Natural Resources (31 July 1976)

d. Others.

University of Texas, Dr. Clark Hubbs (21 June 1976)
City of Irving, Texas, Mayor (24 June 1976)
Mr. Albert Roach (23 July 1976)
County Judge and Commissioner's Court of the County of Franklin (26 July 1976)
North Central Texas Council of Governments (29 July 1976)
(City of Commerce, Texas, Mayor)
(North Texas Municipal Water District)
(City of Irving, Texas)
Southern Methodist University, Dr. Alan Skinner (2 August 1976)
Dr. Douglas S. Gale (9 August 1976)
Ark-Tex Council of Governments (13 August 1976)

6.05 Legal Coordination. On 30 June 1977, copies of the final EIS were forwarded to the US Attorney in Tyler, Texas, for his use in pursuing the legal proceedings necessary to obtain relief from the court injunction of May 1971 and dismissal of the entire lawsuit. The trial was held on 9 through 17 January 1978 and a ruling was issued by the court on 8 December 1978. This ruling declared that the final EIS was legally insufficient and that the project was permanently enjoined from continuing further until such time as an environmental impact statement is filed which corrects the deficiencies noted by the court and complies with the National Environmental Policy Act of 1969 to the fullest extent possible.

This final supplemental EIS incorporating comment and response to the various alternatives presented has been filed with EPA. After a 30-day review period on the final supplemental EIS, a decision will be made regarding the Cooper Lake and Channels project.

INTERAGENCY COORDINATION

6.06 USFWS-TPWD Coordination. Coordination on the authorized project was conducted with USFWS resulting in a USFWS report on 13 July 1966. After the May 1971 court injunction, the USFWS was requested to re-evaluate the fish and wildlife impacts of the project for the draft EIS, resulting in letter reports dated March 8, 1972, and September 3, 1976. A current Coordination Act report is published in appendix B. Continuing coordination has been maintained with the USFWS and TPWD through the period of preparation of the draft EIS to the current date. A complete chronology of coordination on the mitigation issue is included in appendix B.

By Planning Aid Letter dated August 19, 1980, and in a current Coordination Act report, the USFWS provided current recommendations on the Cooper Lake project, relating primarily to the mitigation issue. The following is a response to each of the recommendations in the Planning Aid Letter. A summary of all recommendations and Corps response to the previous USFWS reports is found in appendix B, along with a detailed analysis of the current recommendations.

Planning Aid Letter Recommendations, August 19, 1980

USFWS Recommendation. Any levees which are part of the project be managed for wildlife diversity.

Corps Response. The only levee proposed to be constructed with the Reservoir Only plan now recommended is a spur 4RSS which is needed in conjunction with the outlet channel for Cooper Lake. This spur will continue to provide protection to existing developed land. Approximately 750 acres of land downstream of the dam and upstream of Highway 19/154 are proposed for the purchase as part of the Reservoir Only plan. This land is needed for multiple purposes of flowage regulation at the 3000 c.f.s. discharge, mitigation of bottomland hardwood terrestrial losses, and public use. About 3 miles of existing levee adjoin this tract and a nature trail system is proposed by the Corps along this levee and the new spur 4RSS between the dam and Highway 19/154. Existing levees in the Sulphur River flood plain are owned, operated, and maintained by non-Federal local interests under past agreements, or are privately owned and operated. All levee, however, must be maintained in a condition which primarily will fulfill its flood control purpose. Within the levees adjacent to the river, and interior drainage facilities and borrow areas can be managed for their wildlife value.

USFWS Recommendation. Any levees which are part of the project be designated for public use nature trails.

Corps Response. See response above. Levee Spur 4RSS will be publicly accessible and trail access will be provided.

USFWS Recommendation. Any lands designated for nonstructural flood control be designated as wildlife lands. Such land should be acquired in public ownership.

Corps Response. There are no true natural flood storage areas identified in the Sulphur River Basin. The existing flood plain does function to spread out and slow overbank discharges. The nonstructural plan evaluated in the SEIS designates a habitat zone within the 3-year frequency flood plain. This plan is not selected for implementation in the SEIS. There are no lands acquired for nonstructural flood control with the Reservoir Only plan.

USFWS Recommendation. To compensate for terrestrial wildlife losses resulting from implementation of the Cooper Lake with Flood Control, No

New Channels or Levees (Reservoir Only) about 22,700 acres of bottomland hardwoods, 4,400 acres of open-land, 300 acres of semi-wooded and 6,000 acres of upland woods, as shown on a map which has been provided to your planners, be acquired and managed to a Habitat Unit Value of nine at an estimated O&M cost of five dollars per acre (1980 costs).

Corps Response. The Corps accepts compensation recommendations for bottomland hardwood habitat losses. The Corps recommends acquisition, development and management of about 25,000 acres within the area generally as proposed by USFWS. The Corps also recommends terrestrial habitat mitigation features on project lands at Cooper Lake, and lands downstream of Cooper Dam.

USFWS Recommendation. That compensation lands include those adjoining the upper end of Wright Patman Lake and extend upstream in the White Oak Creek drainage.

Corps Response. The Corps recommended mitigation plan includes mostly these lands.

USFWS Recommendation. Study the feasibility of stage filling. If the study results are positive, and the time and elevation differences between Stage I and Stage II are acceptable for propagation of fish and wildlife, then we recommend stage filling.

Corps Response. The Corps does not accept stage filling recommendations for Cooper Lake. Corps feasibility analysis of stage filling potential at Cooper Lake resulted in a determination that short term benefits of stage filling were not as important as developing the full potential of the lake initially.

USFWS Recommendation. Include in the operations manual, the following release schedules which are designed to mitigate unavoidable stream losses attributable to the creation of Cooper Lake.

a. Upon completion of the impoundment structure, a continuous release of 5 cfs should be implemented until normal operating level is reached or if stage filling is shown to be feasible, then until Stage I is reached.

b. Once the normal operating level or Stage I is reached, a continuous release schedule of (1) 45 cfs for months September through February, (2) 50 cfs for the months March and April, and (3) 30 cfs for the months May through August should be implemented.

c. During a mild drought period (ex. one in four year low flow), the above recommendation (7b) should be reduced by 10 cfs.

d. During a more severe drought period (ex. one in seven year low flow) the recommendation should be reduced to (1) 25 cfs for the

months September through January, (2) 35 cfs for the months February and March, (3) 25 cfs for April, (4) 20 cfs for May, (4) 15 cfs for June, and (5) 10 cfs for the months July and August.

e. During an even more severe drought period (ex. one in ten year low flow), the recommendation should be reduced to a continuous release of 5 cfs for all months.

Corps Response.

a. Accepted. This recommendation will be included in the deliberate impoundment plan.

b. Rejected. Water storage is not available to make a continuous release as requested. The Corps will include in the Operating Plan a procedure for holding 5 percent of the flood pool and making releases at the rate requested for each month when this storage is available. The Corps retains the right to maintain higher release rates when pool stages higher than the 5 percent pool are forecast, or when flood control purposes may be jeopardized due to flood conditions. Monthly release rates and percents may be modified in the future to optimize beneficial downstream effects, only after conducting appropriate hydraulic studies, coordination with the USFWS and TPWD and when such changes would not adversely affect the flood control purpose. A 5 cfs continuous low flow release will be made when lake elevations are below 440 feet msl.

c., d., and e. These releases could also be made, as requested, part of the time through use of retained flood pool storage. However, droughts cannot be predicted and the contingency plans would have to be based on lake levels. Since the Corps plan only utilizes captured flood storage, drought contingency plans are a moot point since elevations of the lake direct the implementation of the USFWS recommended flow when possible.

USFWS Recommendation. List and analyze the techniques available for predicting droughts and relate these findings to the implementation of the above drought contingency plans.

Corps Response. There are no techniques for predicting long term droughts. The maximum rainfall forecast currently used by the National Weather Service is about 3 months, though studies are currently being done to extend forecasts to 1 year. Drought years in North Central Texas and east Texas have occurred on an average frequency of once every 7 years, and two consecutive drought years have occurred on the average of one every 15-20 years. There is, however, no proven way to predict droughts, or to determine if a current drought will continue into the future. The only way to develop contingency plans for downstream releases is to utilize reservoir levels. Since water supply storage is not available for making downstream releases, lake elevations in the flood pool are the only means available for developing contingency plans for Cooper Lake.

Section 2(b) USFWS Coordination Act Report (February 9, 1981).

Recommendation #1. The Corps of Engineers adopt and implement the following release schedules for Cooper Lake:

a. Upon completion of the impoundment structure, a continuous release of 5 cfs be implemented until normal operating level is reached or until stage 1 is reached.

b. Once the normal operating level or stage 1 is reached, a continuous release schedule of (1) 45 cfs for months September through February, (2) 50 cfs for the months March and April, and (3) 30 cfs for the months of May through August be implemented.

c. During a mild drought period (example, one in four years low flow), the above recommendation (b(1)) be reduced by 10 cfs.

d. During a more significant drought (example, one in seven years low flow), the recommendation be reduced to (1) 25 cfs for the months of September through January, (2) 35 cfs for the months February and March, (3) 25 cfs for April, (4) 20 cfs for May, (5) 14 cfs for June, and (6) 10 cfs for the months July and August.

e. During an even more severe drought period (example, one in 10 years low flow), the recommendation should be reduced to a continuous release of 5 cfs for all months.

Corps Response.

a. Accepted. This recommendation will be included in the deliberate impoundment plan.

b. Rejected. The Corps cannot make a continuous release as requested. The Corps will include in the Operating Plan a procedure for holding 5 percent of the flood pool and making releases at the rate requested for each month when this storage is available. The Corps retains the right to maintain higher release rates when pool stages higher than the 5 percent flood pool are forecast, or when flood control purposes may be jeopardized due to flood conditions. Monthly release rates and periods may be modified in the future to optimize beneficial downstream effects, only after appropriate hydraulic studies, coordination with USFWS and TPWD, and when such changes would not adversely affect the flood control purpose. A 5 cfs continued low flow release will be made when lake elevations are below 440 feet msl.

c., d., and e. These releases could also be made, as requested, part of the time through use of retained flood pool storage. However, droughts cannot be predicted, and the contingency plans would have to be based on lake levels. Since the Corps plan only utilizes captured flood storage, drought contingency plans are a moot point since elevations of the lake direct the implementation of the USFWS recommended flow when possible.

Recommendation 2. Cooper Lake be impounded in two phases to complement the water supply/demand analysis.

Corps Response. The Corps does not accept stage filling recommendations for Cooper Lake. Corps feasibility analysis of stage filling potential at Cooper Lake resulted in a determination that short-term benefits of stage filling were not as important as developing the full potential of the lake initially.

At March 1980 price levels, a stage I Cooper Lake providing about 60 mgd dependable yield would have a direct construction cost of $81,832,000 if constructed to allow for ultimate impoundment and operation at the design pools presented for the Reservoir Only plan. This compares to $88,267,000 for the unstaged reservoir recommended in the supplemental EIS. For the second stage of construction, an additional $8,772,000 in construction costs would be incurred, primarily to modify the stage I dam and clear additional areas within the stage II pool. While the total March 1980 costs for a staged project are only $2,400,000 more in direct construction costs, this does not take into account 20 years of inflation on the estimated $8,772,000 in stage II construction costs. The benefits to be gained from a staged project are a temporary postponement in wildlife habitat inundation and a rejuvenation of the reservoir fishery after a period of natural aging. If storage above the stage I pool were used to make interim downstream fishery releases, some of the benefits to terrestrial habitat would be foregone, and the shoreline would have a larger fluctuation zone which would hinder recreation use.

Recommendation 3. That the Corps of Engineers proceed with the terrestrial habitat mitigation plan as presented in the draft supplemental EIS.

Corps Response. Accepted.

Recommendation 4. That the terrestrial mitigation plan presented in the supplemental EIS be implemented concurrent with project construction.

Corps Response. The Corps will not initiate physical construction until Congress has acted on the recommended mitigation plan. Development of the mitigation area and completion of the project will be as concurrent as practical considering the status of the project and budgetary requirements.

Recommendation 5. That when the terrestrial mitigation area has been acquired in fee simple title, fenced, and initial plantings of selected flora completed by the Corps of Engineers, the area be transferred to the TPWD for administration under conditions of a General Plan in accordance with the provisions of and under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. et seq.).

Corps Response. Accepted. Initial development of the area will be accomplished by the Corps, and the TPWD will be offered management of the lands.

Recommendation 6. That the USFWS be provided an opportunity to participate in the preparation of the master plan for the Cooper Lake project.

Corps Response. Accepted. The USFWS will be provided full opportunity to have input into the master plan for Cooper Lake.

6.07 Consideration and Response to Deleted State Comments. Ten letters from State agencies to the Governor's Budget and Planning Office (the clearinghouse for coordinating State agency comments on Federal projects) commenting on the draft EIS (10 June 1976) for the Cooper Lake and Channels project were obtained informally by the Corps of Engineers. The following is a short summary of the 10 letters received and Corps response. The full text of the letters and the full Corps response are found in appendix A which completes the coordination section IX of the final EIS filed 24 June 1977.

a. Texas Parks and Wildlife Department (August 4, 1976). The majority of comments related to factual corrections to wildlife and fisheries use data and design suggestions for improving aspect of the proposed plan to reduce impacts or improve wildlife and fisheries habitat. Most of the factual corrections on use data were incorporated into the monetary evaluations in the final EIS. Suggestions regarding tailwater access reduced channels action, recreation facilities, multi-level outlets, clearing plans, and fishing reefs were either accepted by the Corps, already included in the project plan, or will be given detailed consideration in Recreation Master Planning for the project. Comments by the Department regarding nonstructural alternatives, use of levees for trail systems, recreation use and benefit analysis of the reservoir, and mitigation of unavoidable wildlife and fishery losses are considered and addressed in the supplemental EIS.

b. Texas Water Development Board (July 27, 1976). The Board made several comments supporting the proposed project, mentioned claimed recreation benefits for the reservoir as being underestimated, and made a comment on long term trend information in the draft EIS on agricultural and land use. The Corps has reevaluated recreation aspects and values in the supplemental EIS and conducted additional land use studies for determining long term trends in the basin.

c. Texas Department of Agriculture (July 1, 1976). Comments received concerned the taking of 20,000 acres out of agricultural use and the lack of supporting data for the benefit/cost ratios in the draft EIS. The overall impacts of taking some agricultural land and enhancing the use of other agricultural land as a result of the project were addressed in the final EIS. Support for the benefit/cost ratio and methodology used is now in the supplemental EIS.

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COOPER LAKE AND CHANNELS, TEXAS. SUPPLEMENT.(U)

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d. Texas Forest Service (June 30, 1976). The Service requested more information be included on the value of timber in the affected area, benefits and costs regarding the land use changes and rights-of-way required, and values for commercial fish. These were generally responded to in the final EIS as a result of similar comments by the US Department of Agriculture and others. Benefit/cost analysis is included in the supplemental EIS.

e. Texas Department of Health Resources (July 1, 1976). Comments by the Department addressed the need for adequate wastewater treatment facilities and potable water for the recreation use expected. These will be provided in recreation areas. Other comments addressed the need for additional information on taste and odor problems in the water supply pool related to clearing plans and vector control. These were addressed in the final EIS in response to similar comments from other agencies and in the text.

f. State Department of Highways and Public Transportation (July 26, 1976). This Department expressed concern over sedimentation impacts on highway bridges as a result of past and proposed channelization (draft EIS-authorized plan). With the plan selected and presented in the final EIS, all but completion of 6.7 miles of new channel in conjunction with levees was deleted from the proposed plan.

g. Texas Water Rights Commission (June 23, 1976). The Commission provided comments endorsing the proposed project.

h. Texas Water Quality Board (July 20, 1976). The board provided no comments on the project requiring response.

i. Texas Air Control Board (June 23, 1976). The board provided no comments on the project requiring response, except that vehicle exhaust emissions from recreational use could be discussed.

j. General Land Office (August 11, 1976). This office expressed no objections to the proposed project but requested information be provided by the Corps so the locations of State-owned streambeds as a result of past and proposed channelization could be determined.

6.08 Coordination of the Supplemental EIS. The draft supplemental EIS was circulated for comment by all Federal, State, and local agencies, environmental groups, and individuals on the project mailing list on 20 October 1980. A notice of availability was published in the Federal Register on 31 October 1980. Comments received on the draft supplement have been considered in making recommendations on the Cooper Lake and Channels project included in this final supplement.

6.09 Summary of Public Meeting on Draft Supplemental EIS. On 24 November 1980, a public meeting was held in Sulphur Springs, Texas. Purposes of the meeting were:

a. Review the draft supplemental impact statement, identify and summarize environmental impacts of four alternative plans and the no action alternative to meet or partially meet identified water resource needs of the Sulphur River Basin, Texas, and indicate a tentatively selected plan for recommendation.

b. Present information and accept public response on the acquisition of wildlife habitat mitigation lands, which would be a postauthorization change to the project.

c. Present information and accept public response on the deletion of remaining unconstructed downstream channels and levees from the previously proposed (final EIS) plan, which would also constitute a postauthorization change.

The meeting was attended by about 280 people, and there were 16 oral statements made. Congressman Sam Hall and Congressman-elect Ralph Hall made short presentations. Bob Block of Senator Bentsen's office and Peter Collumb of Senator Tower's office also made short statements. The tone of all the Congressional representation was congratulatory for expediency in getting the deficiencies of the final EIS corrected, and the need to continue to get the project back on track. Sam Hall expressed the need for Sulphur River flood control and also felt a change in priorities (people) would occur over the next 4 years. State Representative Peter Patterson and Delta County Judge, Joe Poage, also spoke in favor of the project.

Richard Roach and Carl Riehn representing NTMWD made a presentation. Major points were that it was difficult for them to accept the delays and subsequent cost increases of Cooper Lake over the years; that the Corps underestimated water supply needs significantly; that NTMWD needs the water and would pay their fair share of Cooper whatever plan the Corps selects; that mitigation for fish and wildlife in a project authorized in 1955 is unfair and places a heavy financial burden on the sponsors; that the Federal Government should pay the total mitigation cost; that they would not accept any releases of water from Cooper Lake which would affect their yield.

Roy McLothlin, a rancher in Red River County, made a short statement against environmentalists and regulation.

Gordon Thorn of TDWR made a statement opposing mitigation in principle and stated that benefits should not be diminished for fish and wildlife purposes; that Congress has not authorized mitigation and TDWR feels it is unjustified; that TDWR concurs with holding the flood pool (5 percent) and the 5 cfs release as adequate aquatic mitigation.

Jay Garrett presented several petitions in favor of the project (Cooper Dam).

Don Abernathy, Dr. Harley Davis, Doug Collins, Larry Skinner, and Morris Partain all presented short statements regarding the need for water from Cooper Lake, concern about delays and inflation, support for the supplemental EIS, and the need to limit environmental regulation.

The full transcript of the public meeting and written statements received is available for public inspection in the Fort Worth District office.

6.10 Comment and Response. Letters of comment received during consideration of the draft supplemental EIS are published here with appropriate Corps response. Changes to the text of the draft supplemental EIS are noted as applicable in the Corps response. An index to the comments is provided in table VI-1.

TABLE VI-1

COMMENTS RECEIVED ON DRAFT SUPPLEMENTAL EIS

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

December 9, 1990

Colonel Donald J. Palladino
District Engineer
Fort Worth District
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

We have completed our review of the Draft Supplemental to the Final Environmental Impact Statement (EIS) on the proposed Cooper Lake and Channels Project, Sulfur River Basin, Texas. The Supplemental EIS re-evaluates two plans previously considered in a Final EIS filed June 24, 1977 and presents a new Water Supply Only Plan and a Comprehensive Nonstructural Plan for comparison. The new plans are presented to respond to noted deficiencies of the Final Statement. This Draft Supplement now provides State agency comments and responses, displays a full benefit/cost analysis, and recommends and provides a full fish and wildlife mitigation plan.

Of the plans originally proposed, the Corps now has selected and recommends the Reservoir Only Plan. This plan provides for the construction for a multipurpose reservoir. All channel and levee work previously proposed for completion under the 1977 plan entitled "Reservoir and Levee Plan" has been eliminated. This includes all of the remaining 27 miles of downstream levee improvements and 6.6 miles of new channel bypass. The change significantly reduces direct and indirect impacts to both wetland and terrestrial wildlife habitat by 75 and 35 percent, respectively. In addition, a full mitigation plan for the identified impacts on terrestrial habitat has been provided for through recommended acquisition and management of 25,000 acres of land. Annual benefits for flood control, water supply, recreation, fish and wildlife, and redevelopment total $5.04 million. The benefit to cost ratio is stated at 1.68.

The following comments are offered for your consideration. These remarks express EPA's views and position on the now selected action while addressing the adequacy of the Supplemental Draft Statement. Our views should provide assistance and direction for development of the Final Supplemental Statement.

1. We agree the now proposed Reservoir Only Plan is an appreciable improvement over the originally proposed Reservoir and Levees Plan. This plan is noted for its efficiency, wetlands consideration, reduction in adverse environmental impacts and overall socioeconomic benefits. It is recognized as the most environmentally sound plan that addresses the critical water supply needs of the area. Although the now recommended plan would provide less flood protection to both agricultural and wooded acres, protection afforded to clear additional acres for agricultural production is significantly reduced. We believe this is a positive approach in meeting the desired objectives of both the wetland and floodplain Executive Orders.

2. The Corps' consideration to the U.S. Fish and Wildlife Service recommendation to fully compensate terrestrial wildlife losses by permanent preservation through acquisition, development, and management of 25,000 acres is commendable. However, we are concerned that the mitigation plan has yet to acquire authorized funding by Congress before it can be implemented. It is therefore believed that authorization should be aggressively sought and emphasized by the Corps District. Language should be developed and presented in the Final Statement insuring that the Corps will pursue acceptance of the proposed Mitigation Plan as described in the Reservoir Only Plan. The EIS should address that the inability to gain authority to implement the mitigation plan may cause need for the District to recommend reconsideration and evaluation of other alternatives that would meet the desired environmental considerations and water supply needs of this area. We believe this to be the most significant issue with this project as proposed and therefore must be positively acted upon in the Final EIS.

These comments classify your proposed action as addressed in the Draft Supplemental Environmental Impact Statement as LO-2. Specifically, our Agency has no objection to the overall proposal and continues to recognize the need for the water supply to be provided by Cooper Lake. We do believe the mitigation plan is a positive approach in meeting the desired objectives for both the wetland and floodplain Executive Orders. For this reason, it is asked that the Corps make a positive effort in recommending to Congress that they accept the overall project features as described (i.e., both the Mitigation and Reservior Only Plans). Futhermore, we are asking the Final Supplement include language indicating that the Corp's continued preference of the overall project would be contingent upon Congressional authorization of both the Mitigation and Reservior Only Plans. Our classification will be published in the Federal Register according to our responsibility to inform the public of our views on proposed Federal actions under Section 309 of the Clean Air Act.

CORPS RESPONSE

1. Noted.

2. The plan recommended by the Corps in this supplemental EIS includes the 25,500 acre White Oak Bayou mitigation area as part of the Reservoir Only plan. We acknowledge that the land purchase requires authorization and funding from Congress. This action has been recommended and will be vigorously pursued. However, we cannot guarantee that the recommended authorization will be forthcoming. The Corps will act in accordance with the Congressional decision in this matter.

Definitions of the categories are provided on the enclosure. Our procedure is to categorize the EIS on both the environmental consequences of the proposed action and on the adequacy of the Impact Statement at the draft stage whenever possible.

We appreciated the opportunity to review the Draft Environmental Impact Statement. Please send our office five (5) copies of the Final Environmental Impact Statement at the same time that it is sent to the Office of Environmental Review, U.S. Environmental Protection Agency, Washington, D.C.

Sincerely,

Frances E. Phillips

for Adlene Harrison
Regional Administrator (6A)

Enclosure

LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

ADEQUACY OF THE IMPACT STATEMENT

Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make a determination.

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
826 FEDERAL OFFICE BUILDING
AUSTIN, TEXAS 78701

December 16, 1980

IN REPLY REFER TO

HA-TX

Draft Supplement to the Final Environmental
Impact Statement for the Cooper Lake and
Channels Project - Texas

Colonel, Donald J. Palladino
District Engineer
Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

We have reviewed the subject document. We have no comments to offer.

Sincerely yours,

George H. Nelson

George H. Nelson
District Engineer

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON 20426

In Reply Refer To:

DEC 22 1980

OEPR-DHRA
Cooperative Studies
Environmental Impact Statement Review
Cooper Lake and Channels, Texas

Mr. William Harrell
U.S. Army Engineer District, Fort Worth
P.O. Box 17300
Fort Worth, Texas 76102

Dear Mr. Harrell:

This is in response to your request for comments on the Draft Supplemental Environmental Statement for the Cooper Lake and Channels Project, Texas.

The Cooper Lake and Channels project, located in the Sulphur River basin, Texas, consists of a multiple-purpose reservoir, levees, and channel improvements. Portions of the project have been completed in accordance with project authorization. Authorized purposes include flood control, water supply, and recreation. Hydroelectric power is not an authorized purpose.

The Commission has previously considered the power potential of the Cooper Reservoir. By its letters dated September 27, 1968, and subsequent review of the Design Memorandum on September 1, 1976, the staff concluded that the proposed Cooper Reservoir would not provide opportunity for the economical development of hydroelectric power and accordingly did not recommend installation of penstocks or other facilities for possible future power development.

Current cursory studies by the Commission staff indicate that, if the firm yield provided by the Cooper Reservoir water supply storage were utilized for hydroelectric power, a dependable capacity of about 5,000 kilowatts could be developed, capable of an average annual generation of approximately 10 million kilowatt-hours. It appears that such a feature would be marginally economically feasible if evaluated as an increment to the authorized project. However, if a large portion of the firm yield is diverted directly from the reservoir to adjacent river basins, the power potential of the

Mr. William Harrell -2- CORPS RESPONSE

Cooper Reservoir would be reduced as a direct proportion to the magnitude of diversions, and the power development would not be economically feasible.

Noted.

We appreciate the opportunity to review the draft supplement.

Sincerely,

William W. Lindsay

William W. Lindsay, Director
Office of Electric Power Regulation

UNITED STATES DEPARTMENT OF COMMERCE
The Assistant Secretary for Policy
Washington, D.C. 20230

DEC

Colonel Donald J. Palladino
District Engineer, Corps of Engineers
Fort Worth District, P.O. Box 17300
Department of the Army
Fort Worth, Texas 76102

Dear Colonel Palladino:

This is in reference to your draft supplement to the final environmental impact statement entitled, "Cooper Lake and Channels, Texas." The enclosed comment from the National Oceanic and Atmospheric Administration (NOAA) is forwarded for your consideration.

Thank you for giving us an opportunity to provide this comment, which we hope will be of assistance to you. We would appreciate receiving three copies of the final statement.

Sincerely,

Robert T. Miki
Deputy Assistant Secretary for
Regulatory Policy (Acting)

Enclosure Memo from: Mr. Robert B. Rollins
National Ocean Survey
NOAA

CORPS RESPONSE

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville Md 20852

DEC 2 1980

OA/C52x6:JLR

TO: PP/EC - Joyce M. Wood

FROM: OA/C5 Robert B. Rollins

SUBJECT: DEIS #8010.16 - Cooper Lake and Channels, Texas (Supplement)

The subject statement has been reviewed within the areas of the National Ocean Survey's (NOS) responsibility and expertise, and in terms of the impact on the proposed action on NOS activities and projects.

Geodetic control survey monuments may be located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, NOS requires not less than 90 days' notification *in advance of* such activity in order to plan for their relocation. NOS recommends that funding for this project includes the cost of any relocation required for NOS monuments.

There are no geodetic control survey monuments located in the proposed lake area.

DEPARTMENT OF HEALTH & HUMAN SERVICES — Public Health Service

Centers for Disease Control
Atlanta, Georgia 30333

(404) 262-6649
December 8, 1980

Colonel Donald J. Palladino
District Engineer
Fort Worth District, Corps of Engineers
Department of the Army
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

We have completed our review of the Cooper Lake and Channels, Texas, Draft Supplemental Environmental Statement. We are responding on behalf of the Public Health Service.

As with any proposed project which involves the relocation of individuals and families, we are concerned with the potential personal impacts involved. The final statement should indicate if relocations and acquisitions will be conducted under the provision of the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970," and address any specific mitigating efforts regarding the personal impacts placed upon the nine families (21 people) involved.

Neither beneficial nor adverse impacts of the proposed work upon local mosquito control problems were considered. If a reservoir is constructed, mosquito breeding conditions could occur and become a public health problem requiring control applications. This possibility, including mitigation measures should a problem arise, should be addressed.

We appreciate the opportunity of reviewing this statement. Please send us a copy of the final statement when it becomes available.

Sincerely yours,

Frank S. Lisella, Ph.D.
Chief, Environmental Affairs Group
Environmental Health Services Division
Bureau of State Services

CORPS RESPONSE

As noted in the supplement, 98 percent of the lands required for Cooper Lake have already been acquired by the Federal Government. The nine families (21 people) mentioned in the statement as requiring relocation have, in fact, already been relocated. This is an impact of Cooper Lake which has already occurred due to the construction status of the project. Although no housing relocations are expected with proposed acquisition of the mitigation areas, the Corps will follow the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 in further real estate activities.

Vector control information was included in the final EIS filed 24 June 1977 in response to comments dated July 6, 1976, from the Center for Disease Control, Public Health Service, Bureau of Laboratories, Vector-Borne Disease Control, Fort Collins, Colorado. There are provisions in the water supply contracts for lowering the lake level for mosquito control purposes, and the Corps conducts mosquito survey and control activities on operating projects.

CORPS RESPONSE

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FORT WORTH REGIONAL OFFICE
221 WEST LANCASTER AVENUE
P O BOX 2905
FORT WORTH TEXAS 76113

REGION VI

IN REPLY REFER TO

December 4, 1980

District Engineer
Fort Worth District
Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Sir:

The draft supplement to the final environmental impact statement (EIS) for the Cooper Lake and Channels Project, Texas, has been reviewed in the Department of Housing and Urban Development's Dallas Area Office and Fort Worth Regional Office and it has been determined that the Department will not have comments on the supplement.

Noted.

Sincerely,

Warren K. McLaury

Warren K. McLaury
Acting Environmental Clearance Officer

AREA OFFICES
DALLAS, TEXAS · LITTLE ROCK, ARKANSAS · NEW ORLEANS, LOUISIANA · OKLAHOMA CITY, OKLAHOMA · SAN ANTONIO, TEXAS

United States Department of Agriculture

Soil Conservation Service

P. O. Box 648
Temple, TX
76501

December 1, 1980

Colonel Donald J. Palladino
District Engineer
Fort Worth District
Corps of Engineers
P. O. Box 17300
Fort Worth, TX 76102

Dear Colonel Palladino:

We have reviewed the draft supplement to the final environmental impact statement for the Cooper Lake and Channels, Texas, and have the following comments.

It is suggested that the Council on Environmental Quality (CEQ) Memorandum, "Analysis of Impacts on Prime or Unique Agricultural Lands in Implementing the National Environmental Policy Act," dated August 11, 1980, be included in the section "Relationship to Public Lands, Executive Orders, and Related Policies Pertaining to Environmental Quality." It appears that the impacts of the recommended plan and alternatives on prime and unique farmlands have been analyzed in the draft supplemental environmental statement.

The draft is not clear, however, as to how much, if any, prime or unique farmlands would be involved in the proposed mitigation areas for wildlife habitat. Commitment of land to such mitigation areas probably would not be irreversible and preclude its future use of agricultural production if such use became of national interest.

Sincerely,

For C. Budd Fountain

George C. Marks
State Conservationist

The Soil Conservation Service is an agency of the Department of Agriculture

SCS-AS-1
10-79

CORPS RESPONSE

A section on the CEQ Memorandum has been added to the Summary in the final supplemental EIS.

The proposed mitigation areas contain the same soil types as are currently farmed in protected areas of the flood plain. Risk of flooding is high, and the mitigation areas contain no significant areas currently farmed intensively. These lands would be considered prime farmland if protected from the flood hazard. You are correct in that the commitment of land to fish and wildlife mitigation is not irreversible if agricultural production becomes of a higher national interest in the future.

Advisory Council On Historic Preservation

1522 K Street, NW
Washington, DC 20005

Reply to: Lake Plaza South, Suite 616
44 Union Boulevard
Lakewood, CO 80228

December 1, 1980

Colonel Donald J. Palladino
District Engineer
Department of the Army
Fort Worth District, Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

This is in response to your request of October 20, 1980 for comments on the draft supplement to the final environmental impact statement (DSFES) for the Cooper Lake and Channels Project, Red River County, Texas.

We note on page 57 of the supplement the statement that the Corps requested the Council's comment on its determination of no adverse effect and that by letter of May 31, 1978 the Council chose not to comment. We wish to point out that contrary to Section 106 of the National Historic Preservation Act and Section 2(b) of Executive Order 11593 the Corps requested Council comment after completing a salvage program on the affected Cooper Lake Archaeological District. The Council did not comment because by the time it received the request all alternatives were foreclosed. The DSFES further states that if additional cultural properties are identified upon resumption of construction, the properties will be evaluated in accordance with the Council's regulations, "Protection of Historic and Cultural Properties," (36 CFR Part 800). While the Fort Worth District is committed to "adequate mitigation," we wish to remind you that should additional cultural properties be discovered during construction it is to follow Section 800.7 of the Council's regulations in determining appropriate treatment.

Should you have questions, please call Jane King at (303) 234-4946, an FTS number, for assistance. We look forward to working with the Fort Worth District, as appropriate, in the future.

Sincerely,

B. H. Storey

Acting Louis S. Wall
Chief, Western Division
of Project Review

CORPS RESPONSE

The investigations conducted in the Cooper Lake area in 1970-72, 1973, 1974, and 1975 were not archeological salvage programs. The investigations were designed to test and evaluate sites which would be affected. Based on the extent and type of information contained in the tested sites and the magnitude of the survey investigations, it was determined through coordination with the National Park Service and the State Historical Preservation Officer that additional mitigation through salvage of cultural resource data was unwarranted. The Corps will collate information from these investigations into a popular summary which should complete mitigative actions agreed to for known sites at Cooper Lake.

The Corps recognizes that additional cultural properties may be discovered during construction and is committed to follow Section 800.7 of the Council's regulations.

Department of Energy
Southwestern Power Administration
Post Office Box 1619
Tulsa, Oklahoma 74101

December 1, 1980

Colonel Donald J. Palladino
District Engineer, Fort Worth
Department of the Army
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

This is in response to your letter of October 20, 1980, enclosing the Draft Supplemental Environmental Statement, Cooper Lake and Channels, Texas. There appears to be no potential for hydroelectric power development at this project considering the need for water supply.

Noted.

In the interest of energy conservation, we recommend to water users that municipal and industrial water be pumped from the lake during non-peak energy consumption periods whenever possible. This would reduce pumping costs and conserve peaking energy. The proposed recreation facilities should be designed as energy efficiently as possible and incorporating solar and wind generating apparatuses. This could increase the first cost of those facilities; however, the saving realized in energy may reduce substantially the operation and maintenance costs.

Water supply sponsors will be informed of your recommendations. We agree that the proposed recreation facilities should be designed as energy efficient as possible, and this will be a consideration in developing master plans and design of facilities.

We appreciate the opportunity to review this report.

Sincerely yours,

Walter M. Bowers

Walter M. Bowers
Chief, Division of
Power Marketing

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

JAN 5 1981

[illegible]
District [illegible], Fort Worth
[illegible]
Department of the Army
[illegible]
Fort Worth, Texas [illegible]

Dear [illegible]:

[illegible] letter dated October 25, 1980, we have reviewed the [illegible] environmental statement for Cooper Lake and [illegible] Counties, Texas. We have both general and [illegible].

[illegible]

1. [illegible] Fish and Wildlife Service (FWS) has worked closely with the Corps [illegible] during the analyses and evaluation of project related [illegible] fish and wildlife and their habitats in the project's area of influence. [illegible] pleased that many of our suggestions made [illegible] have been incorporated in the plan recommended [illegible] statement. This is especially true of those [illegible] related to terrestrial habitats. Although the recommended plan [illegible] will not fully compensate for the terrestrial habitat [illegible] incurred from project construction and operation, the FWS believes the terrestrial mitigation plan is adequate and fully [illegible]. However, we are disappointed that those recommendations which the FWS made regarding measures to offset stream losses have not received support similar to that given for terrestrial habitat losses.

2. Previous Fish and Wildlife Coordination Act reports of July 13, 1966, and September 3, 1976, recommended minimum flow releases from Cooper Lake. Our July 13, 1966, report recommended that "Minimum low-flow releases from Cooper Reservoir during the period June through December by 15 cfs and 10 cfs, respectively, for the first and second 50 years of project life." The Corps signed water supply contracts with local sponsors on March 23, 1968. We find no correspondence from the Corps stating that our recommendations had received equal

CORPS RESPONSE

1. Noted.

2. Traditionally, the Federal Government has not interfered in the State's right to control the use of water within the state's boundaries, the only exceptions being where a Federal project, such as navigation, required storage of water. The Corps of Engineers, in building multiple-purpose projects, has consistently maintained that the Federal purpose in the project is to provide storage space for flood control, navigation, or other authorized Federal interests. Storage space for water supply may also be provided, but the Federal Government has never taken from the State the authority to control use of water in the water supply pool. Storage in the flood pool is not federally appropriated storage since it is only held temporarily. The determination of water usage from storage provided in Cooper Lake has always rested with the State of Texas, resulting in past determinations of the 5 cfs downstream minimum flow as adequate. The water quality storage formerly in Cooper Lake resulted from early determinations by the Corps and the Federal Water Pollution Control Administration (now EPA), concurred in by the State of Texas, that water quality downstream would be protected with these releases. Changes in Federal policy relating to dilution of pollutants by storage, and eventually culminating in PL 92-500, negated the need for water quality storage in Cooper Lake, and this yield subsequently was transferred to water supply, for which needs have continuously increased. The fact that streamflow recommendations were not accepted does not mean they were not given consideration in earlier project planning. Emphasis on protection of instream flows, and the Federal interest in protecting them, has continued to evolve. Current streamflow recommendations made by USFWS are addressed in this supplement, along with current Federal authorities to implement them. Exhibit 1 of appendix B gives a more complete analysis of this issue.

consideration in project planning or why the FWS's flow recommendation could not be met. We do have a letter dated October 6, 1966, which states that the Corps proposes that "the minimum low-flow release from Cooper Reservoir will be 5 cfs plus releases as needed for water quality control, an average yield of 20 cfs being available for this purpose." When water quality control was deleted later as a project purpose, no additional low flows were proposed by the Corps.

On September 3, 1976, the FWS released a Supplemental Fish and Wildlife Coordination Act Report on the Cooper Lake Project which recommended flow "releases be at least equal to or exceed the median monthly stream flow or 10 cfs, whichever is greater." Fourteen months later the Corps signed supplemental water supply contracts with the local sponsors. Again, there is no evidence in our files that our minimum flow recommendations received equal consideration. It should be noted that in both instances our recommendations were made long before the signing of the water supply contracts which bound the full yield of the project.

3. We believe that the final supplemental environmental statement should contain a full discussion on why the FWS's requested minimum flow releases are not being provided as part of the recommended plan. This discussion should include a brief statement describing the Corps' policy on obtaining a State water rights permit for the purpose of protecting public resources and summarizing the legal alternatives.

Specific Comments

Section II

4. Page 12. Net water supply needs are presented for baseline (future without conservation measures) and the future with conservation measures. The table depicts a lower percentage of water saved at the end of the period of analysis than at the beginning. It would appear that as more water saving devices are gradually phased into operation the reverse would be true. The assumptions used to develop the data in this table should be explained.

Section III

5. Page 42, Table III-7. An annualized gain of 96,000 man-days has been attributed to the water supply only alternative for lake sport fishing. The pertinent data provided by the Corps to the FWS indicated that the water supply only reservoir could potentially provide the same benefits as the other reservoir alternatives. Our data indicates a greater demand for lake fishing in the planning area than Cooper Lake can accommodate over the life of the project. We therefore believe that sufficient recreational access areas will be provided at Cooper Lake even if it were constructed by a non-Federal entity.

CORPS RESPONSE

3. Some information on Corps policy relating to water rights and mitigation storage was included in appendix B of the draft supplemental EIS. Exhibit 1 of appendix B has been added to include more detailed data on the instream flow issue, including legal alternatives.

4. Net needs methodology and data are supported in the Water Supply Needs Study which has been published as exhibit 2 of appendix D. There are several reasons for the decreasing percentage of savings attributable to conservation. First, in the baseline projections, the trend in industrial water use reflects increasing recirculation of water. Therefore, the projection of these trends automatically reflects conservation. This has the effect of decreasing the baseline net needs over the years. For municipal use it is assumed that all new construction and all replacement plumbing will be required to use water saving devices. After several years a majority of the existing plumbing fixtures will have been replaced, and so continuation of a conservation program would mean that most of the savings would be from new construction. This means there is a diminishing return effect on the with conservation net needs.

5. The Water Supply Only lake does have the potential to provide the same fishery benefits as the other lake alternatives; however, the Corps believes this potential will not be realized because of the lack of access and facilities. The TORP supports our belief that you cannot assume that, at lakes constructed by a non-Federal entity, that access and facilities will be provided to meet the needs of the public. The TORP points out that one of the State's major problems is the lack of access and facilities at existing lakes in the State. Based on past history it is not logical to assume that a lake without access and facilities would retain the same benefit as one with these facilities. However, even if the full 192,200 man-days of potential lake fishery were added to the Water Supply Only plan, total average annual benefits would only increase by 4 percent, and the Reservoir Only plan would still be much more economically viable than the Water Supply Only plan.

6. On the same table, a loss of 2,154 man-days of stream sport fishing is attributed to the reservoir alternatives. The FWS data and report indicated there would be a loss of 2,254 man-days. An explanation for the difference should be provided in the final statement.

7. Page 43, Table III-8. For the reservoir only alternative, the total average annual benefits are listed as $4,279,150, while summation of the individual benefits listed is $4,834,150. Perhaps the discrepancy comes from the flood control benefits which are listed as $1,305,000. Supportive material in the text of the draft supplement indicates that less flood control benefits would accrue to the reservoir only alternative. Additional information should be provided to explain these figures.

8. Page 44, last sentence of the first three paragraphs. It should be pointed out that all economics related to wildlife and their ecology are are not identified at the current state of the art. The cited monetary losses are therefore conservative due to the lack of data on the value of seed plantings by squirrels, insect catching by cattle egrets, pollinating by bees, to name examples.

Appendix B

9. Page 10, second full paragraph. The Corps recommended $3.00 per acre for operation and maintenance (O&M) of mitigation lands. The FWS recommended $5.00 per acre based on information received from neighboring State game and fish agencies with similar habitats and management objectives. There should be some explanation or justification why the Corps has reduced O&M costs by 40 percent.

10. Page 38, first full sentence. We believe that the Corps' interpretation of the aquatic mitigation analysis is incorrect. The FWS presented aquatic habitat data over a full range of flows and identified the upper and lower limits of flows which had compensatory potential. The Corps' recommended 5 cfs low-flow release established the lower limit, and the optimum flow established the upper limit. Two intermediary flow schedules were also analyzed by the FWS. The results of this analysis indicated that the 5 cfs flow did not provide compensation for upstream losses, but, in fact, reduced the aquatic habitat in the downstream area below what currently exists on an average annual basis. Due to the scarcity of stream segments in the basin which could be managed for mitigation, even the best management plan (optimum release schedule) can only provide 45 percent compensation for losses incurred upstream. To emphasize this point, if yet another project is proposed within the basin, then the opportunity for compensation would be reduced even more. Streams are a vanishing resource. Further analysis is desired.

CORPS RESPONSE

6. All data relating to stream sport fishing losses have been corrected to reflect 2,254 man-days rather than 2,154 man-days used in the draft supplemental EIS.

7. The $1,305,000 in flood control benefits was incorrect and should be $741,000 as in other portions of the supplemental EIS. The total benefit for the Reservoir Only plan was correct. This error has been corrected in table III-8.

8. We concur. The cited man-day losses in these paragraphs are based on man-day use data provided by USFWS and the range of monetary values provided for use in water resource planning studies. These estimates do not count all wildlife economic values unrelated to fishing and hunting, for which there are no accepted calculation methodologies in use. Terrestrial mitigation plans have been recommended primarily on the basis of intangible and still unquantifiable benefits. See also paragraph 3.36 of the final supplemental EIS and response to comment 35 of Texas Committee on Natural Resources following.

9. The $3.00 per acre estimated cost is for 1974 price levels and was ENR indexed back from the $5.00 per acre 1980 price level estimate from USFWS. The $5.00 per acre estimate was used in the 1980 cost/benefit analysis for the selected plan.

10. Based on the USFWS acreage analysis, the 5 cfs continuous outflow by itself (ignoring all passed floodflows and manipulation of downstream flow regimes with the lower 1/3 foot (5 percent) flood pool) would result in less than a 1 percent loss in the habitat available downstream from the dam (622 acres remain of 627 in the without project condition). It is granted that the 5 cfs downstream flow does not compensate for upstream losses (stream inundated). The Corps has presented further analysis in exhibit 1 of appendix B on what we believe constitutes appropriate mitigation flows.

11. Page 38, Corps' Analysis (a). The purpose of the reduction matrices is to (1) display reductions in habitat by life history stage as flow is varied and (2) enable the biologist to identify the optimum flow for the total fishery. The matrices accomplished both of these tasks and provided documentation as to how the optimum flow was identified. A close review of the data does reveal an optimum flow and clearly relates the difference between the optimum condition and the existing condition.

12. Page 39, first full sentence. The data provided in the August 19, 1983, letter does support the relationship between increased flows and increased biological productivity. Low-flows oftentimes limit a species' success by providing more habitat for the life stage(s) which require slack water (such as certain fry and juvenile stages) and not providing enough habitat for the stage(s) which may require more water (such as the adult stage). Therefore, the solution to this problem is to increase the flow and reduce the habitat for those stages which were in surplus and increase habitat for those stages which were limiting. The result of such an action is reflected through an increase in the productivity of the species. This same principle applies to the manipulation of an entire fishery.

13. Page 39, (c) third paragraph. The indiscriminate lumping of life history stages bears no relationship to the ecological processes occurring within the total stream fishery. Low-flow conditions generally provide more habitat for the fry of all species. By totaling these stages, the number appears impressive, but, in fact, does nothing to quantify a species productivity as flow is varied.

14. Page 39-40. As mentioned earlier, the reduction of a particular stage's habitat may not be indicative of the species productivity. A closer analysis of the data may depict a habitat surplus for that particular stage. Short of providing more structure or modifying the channel, streamflow management is the only feasible method for mitigating losses incurred by stream segments elsewhere.

15. Pages 43 and 45. The Corps' data indicate for the early project years that the frequency of a 50 cfs flow would exceed the existing frequency by as much as 25 percent in May (a time of normal surplus) to as little as 3 percent in August (a time of normal shortage). However, in later project years the 50 cfs frequency is reduced below existing rates by 13 percent in May and 9 percent in August. Although the plan provides a limited amount of mitigation on an interim basis, it does not constitute a mitigation plan over the life of the project.

16. Pages 47 and 48, Stage filling. The Corps has studies the feasibility of stage filling and has expressed a number of reasons for opposing such an action. These reasons are summarized in the following list:

CORPS RESPONSE

11. The Corps agrees that both purposes of the reduction matrices are achieved. An optimum flow is identified, and reductions in habitat are displayed by life history stage as flows are varied. But these are habitat reductions from a large array of possible conditions rather than reductions from existing or baseline (without project) conditions. A close review of the data indicate that the existing condition has not been determined and that habitat reductions from existing conditions, therefore, have not been determined.

12. If the USFWS habitat unit data of any life stage are examined, some inverse relationships between flow and habitat are apparent. Spawning largemouth bass and white bass fry in March are only two of many examples for which the data indicate decreasing habitat with increased flows. Additionally, most, if not all, life history stages demonstrate a nonlinear relationship, whether direct or inverse, between flows and habitat units. There is no evidence of any analysis or determination in the USFWS data of which indicator life stages are in surplus under existing conditions. Optimum flows are developed by identifying one species life stage with the greatest habitat reduction at each flow in increments of 5 cfs (up to 100 cfs) and then selecting the flow which shows the least habitat reduction for one life stage of one species. Recommendation of that flow would provide optimum habitat for only one life stage of one species each month. The method does not account for effects of that flow on other species life stages in relation to ecological interactions between all indicator life stages, much less between all life stages of all species which actually occur in the system. USFWS's optimum flows are based on the assumption of a direct and proportional relationship between flow and overall stream productivity which is not supported by PHABSIM data. The Corps cannot support the reduction matrix derived optimum flow as a mitigation flow and due to lack of supporting ecological data, it is also questionable as an optimum flow for the total stream system.

13. There was no intention to demonstrate a relationship between species interactions. The intention of this paragraph was only to illustrate the fact that the PHABSIM data shows both gains and losses of habitat at each flow regimen analyzed when all monthly indicator life history stages of all indicator species are considered of equal importance to the system. It is our contention that recommendation of a monthly flow which least affects only one of the most affected life stages, as was done by USFWS, is not valid for the total stream system because of lack of consideration of ecological processes. Such a recommendation merely optimizes habitat for one life history stage of one indicator species for each month and assumes all other species are affected less.

CORPS RESPONSE

14. It is agreed that, short of providing more structure or modifying the channel, streamflow management is a feasible method for mitigating stream losses. The facts remain, however, that the relationship between flows and productivity varies greatly between life history stages and species, life stage interrelationships have not been considered in the USFWS recommendations, and habitat surpluses have not been identified for any life stage under without project conditions. The streamflow recommendations of the USFWS optimize habitat for only one life stage of one species per month and do not necessarily address the objective of mitigating overall natural stream system losses. Additionally, any structural habitat modification measures would have to be targeted at individual species of management interest. No such fishery management interests have been provided by the USFWS since their stated mitigation objective is to compensate for losses to the natural stream system.

15. These analyses were presented to show that a 50 cfs release (maximum USFWS proposed mitigation flow) could be made a significant percent of time through tailing off the lower 5 percent of the flood pool. Reducing the 50 cfs rate to the flows recommended as mitigation in other months by USFWS will extend the percent time even more. The Corps believes that through more detailed analysis of operating procedures, a downstream flow utilizing the 5 percent flood pool can be developed to maximize the mitigation of stream losses while not significantly impacting flood control benefits.

16. Corps water supply needs studies indicate a need for more than half the yield in less than 20 years. The NTMWD has provided data indicating greater needs, much earlier (*exhibit 1 of appendix D*), and has expressed concern over planning for average, or historic conditions, rather than system stress. Recreation facilities constructed above the ultimate pool in a staged project would be more distant from the water resources, with their use attractiveness lessened. Relocation of boat ramps or other facilities would be an expense chargeable to the water supply sponsors, for which they receive no benefits.

At March 1980 price levels, a stage I Cooper Lake providing about 60 mgd dependable yield would have a direct construction cost of $81,832,000 if constructed to function properly while allowing for ultimate impoundment and operation at the design pools presented for the *Reservoir Only plan*. This compares to $88,267,000 for the unstaged reservoir recommended in the supplemental EIS. For the second stage of construction, an additional $8,772,000 in construction costs would be incurred, primarily for stripping and additional fill on the embankment, road work, and clearing additional areas within the stage II pool. While the total March 1980 costs for a staged project are only $2,400,000 more in direct construction costs, this does not take into account 20 years of inflation on the estimated $8,772,000 in stage II construction costs. The benefits to be obtained from a staged project are a temporary postponement in wildlife habitat inundation (which has been almost fully mitigated with the proposed plan), and a rejuvenation of the reservoir fishery after a period of natural aging. The average annual fishery man-day gains for a stage-filled project are 214,344, compared to 192,202 for the proposed project, based on USFWS data. This would increase average annual benefits by about $33,200 or less than 0.5 percent of the total benefits at 1980 price levels.

(1) Water supply studies indicate that more than half of the storage will be required within twenty (20) years.

(2) Recreational facilities would be lost when the second stage is reached.

(3) The smaller initial pool would reduce the lake fishery and reduce economic benefits.

(4) Lake fluctuations, which would result from the regulated release of water above the initial stage, would have adverse impacts on the reservoir.

In addressing the first point, the FWS believes that twenty years is sufficient time between stages to benefit the lake fishery and provide water on an interim basis for downstream releases. The Corps has already proposed a solution to point number two by designing the facilities to include the relocation of the boat ramps only. The boat ramps undergo periodic repairs so relocation is only a minor additional expense. As far as point number three is concerned, stage filling provides more overall fishery benefits on an average annual basis than an immediate fill. Finally, lake fluctuations, attributed to the downstream fishery releases is considered to be insignificant during an average water year.

17. Page 54, first full paragraph. In the discussion of water quality downstream from Wright Patman Dam, it is stated "The conclusion reached in that investigation, utilizing a selective withdrawal model (SELECT) was that provision of multiple-level outlet structures would not substantially improve the quality of released water, but would serve to deplete available dissolved oxygen in the reservoir." How can the oxygen in the reservoir be depleted without substantially improving water quality downstream?

We trust these comments will be of assistance to you.

Sincerely,

[illegible] H. [illegible]berger
[illegible] to
[illegible] SECRETARY

CORPS RESPONSE

As for lake fluctuations, some flood water storage would occur almost annually in the Sulphur River Basin. Based on area-capacity data for Cooper Lake, a first stage project at conservation pool (427 feet msl) capturing 10,500 acre-feet of flood storage would have a pool rise of 1 foot. The project at the proposed 440 feet msl pool would have a less than 0.5 foot pool rise with the same storage. The full size project can capture 104,000 acre-feet of flood storage with a 5 foot rise into the flood pool. A staged project capturing the same quantity of flood storage would have a pool rise greater than 8 feet. In addition, water supply withdrawals or interim downstream releases from an initial stage project would cumulatively add to fluctuations of lake levels more than with the full size project. Lake fluctuation as a fishery management tool is only beneficial if the timing of drawdowns can be completely controlled, which is not the case in a multiple purpose project.

17. (Page 54, appendix B of draft supplemental EIS). The referenced model study indicated a maximum predicted increase of 0.7 mg/l of dissolved oxygen in outflow with structural modification of Wright Patman Lake. Due to the fact that a number of areas of concern cause periodic low dissolved oxygen downstream, it was concluded that regardless of the small improvement in quality which could be achieved with modification of the Wright Patman outlet works, deficiencies would still occur periodically due to the stream's inability to assimilate its waste load input. Releases from the higher quality water in upper levels of the lake would serve to decrease water quality in the lake slightly.

OFFICE OF THE GOVERNOR

WILLIAM P. CLEMENTS, JR
GOVERNOR

December 22, 1980

Colonel Donald J. Palladino, District Engineer
Fort Worth District, U. S. Corps of Engineers
Post Office Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

The draft Supplemental Environmental Statement pertaining to Cooper Lake and Channels, Texas, prepared by your Office, has been reviewed by the Budget and Planning Office and interested state agencies. No agency comments have been received in this Office. I understand that several comments have been sent directly to you by state agencies. I hope they are helpful. The State Environmental Impact Statement Identifier Number assigned to the project is 0-10-50-069.

The Budget and Planning Office appreciates the opportunity to review this project. If we can be of any further assistance during the environmental review process, please do not hesitate to call.

Sincerely,

F. R. Spies

F. R. Spies, Manager
General Government Section
Budget and Planning Office

mp

SAM HOUSTON BUILDING • P O BOX 12428, CAPITOL STATION • AUSTIN, TEXAS 78711

TEXAS
PARKS AND WILDLIFE DEPARTMENT

CHARLES D. TRAVIS
EXECUTIVE DIRECTOR
4200 Smith School Road
Austin, Texas 78744

December 15, 1980

Colonel Donald J. Palladino
District Engineer
US Army Engineer District, Fort Worth
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Re: Cooper Lake and Channels, Draft Supplement to the EIS

Dear Colonel Palladino:

The referenced document has been reviewed by this Agency, and my staff concurs with your selection of the Reservoir Only Alternative. The mitigation measures proposed in this document, furthermore, are supported by this Department. It is hoped, however, that the proposed instream flow schedules can be adjusted so that downstream fish populations are better supported.

The opportunity to coordinate with you on this matter is appreciated.

Sincerely,

Charles D. Travis
Executive Director

CDT:JDR:bdj

CORPS RESPONSE

Noted. We additionally revised the final supplement to state that release rates from the 5 percent flood pool may be modified in the future pending more detailed hydraulic and biological studies, and coordination with USFWS and TPWD on operating plans to best support downstream multiple uses.

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION
AUSTIN, TEXAS

November 1_, 198_

D8-L 854

Draft Supplemental Environmental Statement
Cooper Lake and Channels Project

Colonel Donald J. Palladino
U.S. Army Corps of Engineers
Post Office Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

Thank you for the opportunity to review the draft supplement covering the Cooper Lake and Channels Project.

The Department has no comment regarding the proposed plans.

Noted.

Sincerely yours,

M. G. Goode
Engineer-Director

By: James M. Barr for
R. L. Lewis, Chief Engineer
of Highway Design

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

CORPS RESPONSE

January 8, 1981

RECEIVED
JAN 9 1981
Budget/Planning

Mr. Paul Wrotenbery, Director
Governor's Budget and Planning Office
Sam Houston State Office Building
7th Floor, P. O. Box 12428
Capitol Station
Austin, Texas 78711

Dear Mr. Wrotenbery:

Please refer to your memorandum of November 7, 1980 transmitting for our review the U. S. Army Corps of Engineers' Draft Supplemental Environmental Statement on Cooper Lake and Channels, Texas.

1. The Texas Department of Water Resources is seriously concerned over the water supply problems and needs of the North Texas Municipal Water District, the City of Irving, and the Sulphur River Municipal Water District, all of which will utilize water from Cooper Lake when it is ultimately constructed. The City of Irving and customer cities of the North Texas Municipal Water District are among the fastest growing municipalities in Texas.

1. Noted.

Initially, we wish to commend the Fort Worth District of the Corps of Engineers for their excellent work on this report since jurisdiction over the Cooper Lake and Channels Project was transferred to them in 1979. We believe that the Supplemental Environmental Statement adequately addresses the alleged deficiencies of the 1975 Final Environmental Impact Statement for the project as set forth in Memorandum Opinion issued December 8, 1978 by the United States District Court for the Eastern District of Texas. It is our sincere hope that the present Court injunction against this urgently-needed project will be lifted and construction can be continued as expeditiously as possible.

P.O. Box 13087 Capitol Station • Austin, Texas 78711 • Area Code 512/475-3187

Mr. Paul Wrotenbery, Director
Page 2
January 8, 1981

2. We regret that we cannot fully concur with the magnitude of fish and wildlife mitigation measures recommended in the draft report, which would add an additional estimated $12.6 million dollars to project costs, even though the recommended mitigation plan involves significantly less federal land acquisition than the 33,403 acres recommended by the U. S. Fish and Wildlife Service. We wish to emphasize that mitigation of potential wildlife habitat loss by additional land acquisition was not included in the 1955 Congressional authorization of the Cooper Lake and Channels Project and that such action will require a post-authorization change which must be approved by Congress.

3. With respect to other proposed mitigation measures, the Department has no objection to the Corps' recommendation that releases for aquatic mitigation be made from water held in the bottom 5 percent of the flood storage pool, when available.

4. With respect to the proposed recommendation that a continuous minimum low flow release of 5 cfs from the reservoir be maintained, we wish to emphasize that such releases would constitute an enhancement of natural flow conditions of the South Sulphur River, which frequently experiences no-flow conditions and commonly has flows of less than 5 cfs. The existing water rights permits for Cooper Lake do not contain provision for continuous releases for downstream fish and wildlife maintenance and enhancement, nor do the existing water supply contracts between the federal government and the three local project sponsors have any such provision.

We appreciate the opportunity of reviewing this document. If we can be of further assistance, please advise.

Sincerely yours,

Charles E. Nemir
for Harvey Davis
Executive Director

cc: Fort Worth District, Corps of Engineers

CORPS RESPONSE

2. Noted. It is further noted in the supplemental EIS that the current terrestrial habitat mitigation plan will require authorization by Congress.

3. Noted.

4. The water rights permits do not contain a specific provision relating to minimum downstream releases. However, the provision to make the 5 cfs low flow release is a part of the water supply storage contracts. The local sponsors have water rights permits for their storage and have agreed by contract to release this portion of their water downstream, primarily for water quality maintenance. By written statement at the public meeting on 24 November 1980, the TDWR did not object to the 5 cfs continuous low flow release. We acknowledge the TDWR's authority to administer State water rights. Releases from Cooper Dam will conform to appropriate orders of the TDWR.

ARKANSAS
DEPARTMENT OF
FINANCE AND
ADMINISTRATION

Bill Clinton
Governor

William D. Gaddy
Director

OFFICE OF
INTERGOVERNMENTAL SERVICES

P.O. Box 3278 Little Rock, AR 72203
Telephone Area Code (501) 371 1074 or 371 2311

December 5, 1980

Department of the Army
Fort Worth District
Corps of Engineers
P.O. Box 17300
Fort Worth, TX 76102

RE: EIS-0272 Cooper Lake & Channels Project

Dear Sir:

The State Planning and Development Clearinghouse is in receipt of the above environmental document pursuant to Section 102(2)(c) of the National Environmental Policy Act of 1969 and the Arkansas Project Notification and Review System.

To carry out the review and comment process, this document was forwarded to members of the Arkansas Technical Review Committee. Resulting comments received from the Technical Review Committee which represent the position of the State of Arkansas are attached. Forthcoming comments will be forwarded to you for your consideration.

The State Clearinghouse wishes to thank you for your cooperation with the Arkansas Project Notification and Review System.

Sincerely,

Shirley J. Thomas

Shirley J. Thomas, Director
State Clearinghouse

SJT/ms
cc: John Saxton, TRC

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Arkansas Soil and Water Conservation Commission

MEMORANDUM E.I.S. Review

TO: Shirley J. Thomas, Director, State Clearinghouse **DATE:** 11-24-80

FROM: John P. Saxton, Chairman, Technical Review Committee

SUBJECT: EIS-0272 - Draft Supplemental Environmental Statement - Cooper Lake and Channels, Texas

We have reviewed the above listed Draft EIS and have no comments to offer.

Comments from members of the Technical Review Committee are attached. Others will be forwarded as and when they are received.

JPS:cc

Enclosures

RECEIVED
NOV 25 1980
INTERGOVERNMENTAL SERVICES

ARKANSAS
DEPARTMENT OF FINANCE AND ADMINISTRATION

OFFICE OF BUDGET
INTERGOVERNMENTAL SERVICES

P.O. Box 3278 Little Rock AR 72203
Telephone Area Code (501) 371 1074 or 371 2311

M E M O R A N D U M

TO: All Technical Review Committee Members

FROM: Shirley J. Thomas, Director SJT
State Planning & Development Clearinghouse

SUBJECT: 404 Notice No. ______

EIS No. 0272

DATE: October 24, 1980

Please review the above stated document under provisions of Section 404 of the Clean Water Act Section 102 (2) (c) of the National Environmental Policy Act of 1969, and the Arkansas Project Notification and Review System. Please mail your comments within fifteen (15) days to John P. Saxton, Chairman, Technical Review Committee.

- [ ] Support
- [x] No Comment
- [x] Comments Attached
- [ ] Do Not Support (Comments Attached)
- [ ] Support with the Following Conditions
- [ ] Non-degradation Certificate Issued (applies to Dept. of P.C.& E. only)

Please see attached Game & Fish Letter

Signed DH Cramer Date 10-29-80

Agency PC & E

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ARKANSAS GAME AND FISH COMMISSION
October 29, 1980

Signed - R. W. BROACH

MEMORANDUM TO: John P. Saxton, Chairman
Technical Review Committee

FROM: Richard W. Broach, Member
Technical Review Committee

OCT 29 1980

REFERENCE: EIS No. 0272

Receipt is acknowledged of an October 24, 1980 memorandum from the State Planning & Development Clearinghouse and the attached Draft Supplemental Environmental Statement for the Cooper Lake and Channels Project.

Comments submitted to the Ft. Worth District, U. S. Corps of Engineers by the Arkansas Game and Fish Commission August 29 are included in the draft. We have no additional comments at this time.

RWB:ac

cc: U. S. Fish & Wildlife Service

Arkansas
Game and Fish Commission

No. 2 Natural Resources Dr
Little Rock, Arkansas 72205
(501) 371-1025

August 29, 1980

Colonel Charles W. Lively
Acting District Engineer
Fort Worth District, Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Lively:

Receipt is acknowledged of your letter of August 22, 1980 concerning planning aid information provided to the Ft. Worth District by the U. S. Fish and Wildlife Service in connection with the Cooper Lake and Channels Project. You have requested State wildlife agency review of data provided in the Service's planning aid letter pursuant to relevant sections of the Fish and Wildlife Coordination Act.

1. The Service has requested a flow release schedule for fisheries habitat maintenance through Cooper and Wright-Patman Lakes into the Sulphur River and has recommended that some type of multilevel outlet structure be incorporated into the Wright-Patman project to insure suitable water quality for maintenance of aquatic life in the Arkansas portion of the river below Wright-Patman dam.

Previous reports and correspondence have established the value of the 16,000-acre Sulphur River Wildlife Management Area in Miller County, Arkansas to varied forms of resident wildlife and fishes. Overflow lakes on the management area support populations of warmwater fish species including largemouth bass, crappies, bluegill, catfishes and a variety of commercial fishes. The Sulphur River Area provides important wintering ground for migratory waterfowl and contains habitat which is adjudged to be critical to survival and recovery plans for the American alligator (United States list of Endangered Fauna). Aquatic life systems in this unique and vital wetlands tract are ultimately dependent on flows from the main stream of Sulphur River. Water quality in Sulphur River, of course, has been deleteriously affected by municipal and industrial wastes and by low-volume, hypolimnial

CORPS RESPONSE

1. Noted. The Arkansas Game and Fish Commission's letter of August 29, 1980, was published in appendix B of the draft supplemental EIS. Response in appendix B was as follows.

"Optimum multiple use is, and will continue to be, a factor in the development of Cooper Lake. Storage reallocation or release schedule changes at the existing Wright Patman Lake is beyond the scope of the Cooper Lake project study, but will be considered in future feasibility studies for storage conversion at Wright Patman Lake, or in conjunction with ongoing water quality studies.

"Multiple use of storage provided in Cooper Lake for downstream purposes is not possible. Flood storage capacity in Cooper Lake is designed to provide protection to downstream agricultural lands. Holding of more than a minor portion of this storage to make downstream multiple-purpose releases for fish and wildlife increases the risk of flooding to these developed lands. Multiple use of water supply storage in the two reservoirs is also not possible since the water supplies are used by different entities in different locations within the state. The Cooper Lake water supply is used upstream of Cooper Dam.

"An investigation of water quality below Wright Patman Dam and effects of structural modification to the outlet works was conducted by the Corps (New Orleans District) culminating in a report dated 16 July 1979. The conclusion reached in that investigation, utilizing a selective withdrawal model (SELECT), was that provision of multiple-level outlet structures would not substantially improve the quality of released water, but would serve to deplete available dissolved oxygen in the reservoir. Dissolved oxygen in released water met all applicable criteria during the years 1975-1977. In 1979, a low runoff year, the lower Sulphur River basin did experience low dissolved oxygen concentrations, in both the reservoir and downstream channel areas.

"The Corps has a continuing program of evaluating water quality and instream flow needs within and downstream of operating projects. This recommendation, however, is not applicable to Cooper Lake and Channels project."

releases from Wright-Patman dam. Although current minimum releases approximate 10 cfs, earlier fish and wildlife reports have recommended a minimum release of 100 cfs from Wright-Patman for maintenance of downstream wildlife and fisheries resources. Releases from the dam are withdrawn from a stratum of severe oxygen stress which is associated with acute oxygen demands which occur in the bottom of the reservoir during reservoir stratification. These oxygen demands are created by the decomposition of organic matter and by chemical oxydation processes involving reduced ions of iron, magnesium, sulphur, etc. which occur in anaerobic conditions. While the mechanical process of releasing these waters from Wright-Patman dam temporarily oxygenates flows in the river, sustained chemical oxygen demands occur at points downstream resulting in occasional fish kills and fish populations which are dominated by undesirable or "rough" fishes. Releases, then, from Wright-Patman dam are insufficient, both quantitatively and qualitatively, to sustain aquatic ecosystems in the Sulphur River and can be expected to adversely affect adjacent wetlands and overflow lakes. The obvious solution to this problem would be to withdraw sufficient quantities of water from the upper stratum of Lake Texarkana.

In summary, epilimnial releases from Wright-Patman Dam in quantities approaching 100 cfs should suffice to offset environmental degradation which has occurred in the Arkansas portion of Sulphur River as a result of Wright-Patman dam and other factors discussed in this letter.

We very much appreciate the opportunity to comment on the Planning Aid letter and if we can be of further assistance to the Ft. Worth District or the U. S. Fish and Wildlife Service as these matters are considered for remedial actions, we will be pleased to do so.

Cordially,

Steve N. Wilson,
Director

SNW:RWB:ac

cc: U. S. Fish & Wildlife Service
Ecological Services
Fort Worth, Texas 76102

ARKANSAS
DEPARTMENT OF FINANCE AND ADMINISTRATION

Bill Clinton
Governor

R. L. Ulla
Director

OFFICE OF BUDGET
INTERGOVERNMEN

P.O. Box 3278 Little Rock AR 72203
Telephone Area Code (501) 371

RECEIVED
OCT 28 1980
ARK. DEPT. of HEALTH
DIVISION OF ENGINEERING

M E M O R A N D U M

TO: All Technical Review Committee Members

FROM: Shirley J. Thomas, Director, SJT
State Planning & Development Clearinghouse

SUBJECT: 404 Notice No. ______________

EIS No. 0272

DATE: October 24, 1980

Please review the above stated document under provisions of Section 404 of the Clean Water Act Section 102 (2) (c) of the National Environmental Policy Act of 1969, and the Arkansas Project Notification and Review System. Please mail your comments within fifteen (15) days to John P. Saxton, Chairman, Technical Review Committee.

- [ ] Support
- [x] No Comment
- [ ] Comments Attached
- [ ] Do Not Support (Comments Attached)
- [ ] Support with the Following Conditions
- [ ] Non-degradation Certificate Issued (applies to Dept. of P.C.& E. only)

Signed Bruce Kirsch[illegible] P.E. - Director Date 11-12-80

Agency Division of Engineering
Ark Dept of Health

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DEPARTMENT OF FINANCE AND ADMINISTRATION

OFFICE OF BUDGET
INTERGOVERNMENTAL SERVICES

P.O. Box 3278 Little Rock AR 72203
Telephone Area Code (501) 371-1074 or 371-2311

M E M O R A N D U M

TO: All Technical Review Committee Members

FROM: Shirley J. Thomas, Director SJT
State Planning & Development Clearinghouse

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Signed Bill Shepherd for Harold Grimmett Date November 3, 1980
Agency Natural Heritage Commission

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DEPARTMENT OF FINANCE AND ADMINISTRATION

OFFICE OF BUDGET
INTERGOVERNMENTAL SERVICES

P.O. Box 3278 Little Rock AR 72203
Telephone Area Code (501) 371 1074 or 371 2311

MEMORANDUM

TO: All Technical Review Committee Members

FROM: Shirley J. Thomas, Director SJT
State Planning & Development Clearinghouse

SUBJECT: 404 Notice No. ______

EIS No. 0272

DATE: October 24, 1980

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Signed James T. Dyke, Director Date 10/28/80

Agency Dept. of Econ. Dev.

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ADMINISTRATION

OFFICE OF BUDGET
INTERGOVERNMENTAL SERVICES

P.O. Box 3278 Little Rock AR 72203
Telephone Area Code (501) 371 1074 or 371 2311

M E M O R A N D U M

TO: All Technical Review Committee Members

FROM: Shirley J. Thomas, Director SJT
State Planning & Development Clearinghouse

SUBJECT: 404 Notice No. ______

EIS No. 0272

DATE: October 24, 1980

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- ☐ Support
- ☒ No Comment
- ☐ Comments Attached
- ☐ Do Not Support (Comments Attached)
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Signed Gary Baker Date Oct 28 1980

Agency Ark State Parks

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ARKANSAS
DEPARTMENT OF FINANCE AND ADMINISTRATION

Bill Clinton, Governor

R. L. Qualls, Director

OFFICE OF BUDGET
INTERGOVERNMENTAL SERVICES

P.O. Box 3278 Little Rock AR 72203
Telephone Area Code (501) 371-1074 or 371-2311

M E M O R A N D U M

TO: All Technical Review Committee Members

FROM: Shirley J. Thomas, Director SJT
State Planning & Development Clearinghouse

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- [ ] Do Not Support (Comments Attached)
- [ ] Support with the Following Conditions
- [ ] Non-degradation Certificate Issued (applies to Dept. of P.C.& E. only)

Signed James D. Gaither Asst Div. Head Env. Div. Date 11/12/80

Agency Arkansas Hwy & Trans Dept

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TEXAS INDEPENDENT BIRD HUNTERS ASSOCIATION, INC.
NON PROFIT STATEWIDE
P.O. BOX 38363 DALLAS, TEXAS 75238

CORPS RESPONSE

TO: Donald Palladino, District Engineer
DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102

Whereas, Texas lands are 90% plus privately owned creating a huge need for public lands for many uses including hunting, and

Whereas, the Cooper Dam Project will remove approximately 29,000 acres from public hunting, and

Whereas, this loss of habitat will create a hardship for those who hunt on public lands for various reasons, the primary reason being cost and availability of private leases, and

> The Cooper Lake Project will inundate and cause the loss of 19,000 acres of private lands. Approximately 7,000 acres of perimeter lands will be made available for public hunting at the Cooper Lake Project where formerly there was no public hunting.

Whereas, the cost of mitigation lands will add only 10% or approximately $12 million to the cost of the project, and

Whereas, most of the Texas Independent Bird Hunters Association, Inc. membership lives in the area to be served by Cooper Dam water, and

Whereas, the membership realize part of the cost of mitigation lands will be reflected in our future water bills, and

Whereas, we are more than willing to bear this additional cost,

Now therefore be it resolved, the Texas Independent Hunters Association, Inc. does support the selected plan described in the Supplemental Enviromental Impact Statement which includes a fish and wildlife mitegation plan of approximately 26,000 acres, and deletion of channels and levies.

> Noted.

Affirmed this 3rd. day of December, 1980 at our membership meeting by unanimous vote at Richardson, Texas.

Alvin W. [illegible], President

Dave Dunlap, Vice President, Administration

Ron Stephens, Secretary

Ron Stephens

BOBWHITE, THE HARDY KING AND QUEEN OF THE UPLAND GAME BIRDS!

TEXAS INDEPENDENT BIRD HUNTERS ASSOCIATION, INC.
NON PROFIT · STATEWIDE
P.O. BOX 38363 · DALLAS, TEXAS 75238

December 9, 1982

Mr. [illegible], Civil Engr
[illegible] Army
Fort Worth Dist. Corps of Engrs
P.O. Box 17300
Fort Worth Tx 76102

Re: Cooper Dam Project

Dear Sir

In reference to the above subject and considering the fact that 19,000 acres will be removed from public hunting, I would to you record as supporting the [illegible] plan described in the Supplemental Environmental Impact Statement which includes a fish and wildlife mitigation plan of approximately 26,000 acres [illegible] addition of channels and levees

Thank you for your consideration [illegible] my appeal to you for your assistance in this matter of public concern to those of us who live in this area

Respectfully
Leo C. Koehel Jr.
703 Lorrie Dr
Richardson TX 75[illegible]

BOB WHITE, THE HARDY KING AND QUEEN OF THE UPLAND GAME BIRDS!

CORPS RESPONSE

The Cooper Lake Project will inundate and cause the loss of 19,000 acres of private lands. Approximately 7,000 acres of perimeter lands will be made available for public hunting at the Cooper Lake Project where formerly there was no public hunting.

Sportsmen's Clubs of Texas, Inc.

EXECUTIVE OFFICES • 311 VAUGHN BUILDING • AUSTIN, TEXAS 78701

ALAN ALLEN
Executive Director
472 2267

AFFILIATED WITH
NATIONAL WILDLIFE
FEDERATION

December 3, 1980

Colonel Donald J. Palladino
District Engineer
Army Corps of Engineers
District Office
Post Office Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

After studying the Cooper Lake and Channel supplemental EIS, the Sportsmen's Clubs of Texas takes a position of supporting the acquisition of the 29,783-acre mitigation area recommended in the EIS. Or at least some other suitable habitat.

SCOT also asks that provisions be made to provide base-flow releases as has been recommended by the U. S. Fish and Wildlife Service.

Thank you for the opportunity to peruse this information, and for your consideration.

Sincerely,

ALAN ALLEN
Executive Director

AA:pn

CORPS RESPONSE

The mitigation area recommended by the Corps consists of acquisition of 25,500 acres.

The USFWS recommended optimum downstream releases, not base flows, to mitigate for stream losses. The Corps recommended 5 cfs continuous low flow and manipulation of the 5 percent flood pool should constitute an acceptable base flow downstream of the dam.

THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS 78712

Department of Zoology

October 23, 1980

Col. Donald J. Palladino
Department of the Army
Fort Worth District,
Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Col. Palladino:

I have your communication entitled "Cooper Lake and Channels, Texas Draft Supplemental Environmental Statement." I am perplexed concerning the protocol used in this statement. If it is to be assumed to be merely a supplement to the 24 June 1977 EIS, then a reader would need a copy of that EIS to understand the contents of this ammended EIS. In as much as discussion of the merits of that EIS occurred in trial in Tyler during January 1978 (does that date occur anywhere in this supplemental EIS?) a summarization of those comments would benefit many readers.

I am certain that you are aware that I extensively criticized the aquatic biology component of the 1977 EIS and feel it was deficient and misleading. I do not see any resolution to my concerns in the supplement. It seems strange to me that those data I stated to be deficient in 1978 have not been supplemented two years later. As the current plan differs substantially from the one discussed in court, the data base should have been supplemented or reinterpreted to ascertain if the conclusions on aquatic biology are valid.

Sincerely,

Clark Hubbs

Clark Hubbs
Professor and Chairman
Department of Zoology

CH/lf

CORPS RESPONSE

The draft supplemental EIS and this final supplemental EIS correct five deficiencies noted by the Court in the Memorandum Opinion dated 8 December 1978. Many issues were discussed at the trial in January 1978, but few relate to the five noted deficiencies. The final EIS is a public document of record and is available in the Fort Worth District Office. Transcripts of the trial are also publicaily available.

Responses addressing your concerns on aquatic biology were included in the final EIS (24 June 1977) and were a subject of the trial hearing 9-17 January 1978. The quantity and quality of aquatic data were not a noted deficiency except as it may relate to development of a fish and wildlife mitigation plan in coordination with the USFWS and TPWD. The Reservoir feature of the currently recommended plan is the same as that in the final EIS, with the exception that flood pool manipulations will be made to supplement downstream low flow releases. This change, plus deletion of the remaining unconstructed channels from the recommended plan, will complement the aquatic resources downstream and reduce adverse impacts.

Wildlife Management Institute

709 Wire Building, 1000 Vermont Ave., N.W., Washington, D.C. 20005 • 202/347-1774

DANIEL A. POOLE
President
L. R. JAHN
Vice President
L. L. WILLIAMSON
Secretary
JACK S. PARKER
Board Chairman

PLEASE REPLY TO:
Murray T. Walton
Southcentral Representative
Star Route 1A, Box 30G
Dripping Springs, Texas 78620
512-825-3473

December 22, 1980

Colonel Donald J. Palladino
U.S. Army Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

The Wildlife Management Institute has reviewed the Draft Supplemental Environmental Statement for the Cooper Lake and Channels, Texas Project. Although we are pleased to see that acquisition of mitigation land is recommended, we find serious shortcomings in this document and the proposed action.

1. The recommended mitigation land appears to be an ideal area, however, should this area not be available, other suitable lands in the Sulphur River Basin should be considered (especially lands from willing vendors). The Final Statement should identify such lands.

2. The Supplemental Statement fails to satisfy the Court's instructions concerning recreational benefits and monetary value of fish and wildlife recreation. Proof that Cooper Lake is needed for recreation (page 13 and elsewhere) is not supported by TORP. In fact, the TORP data cited in the Supplement demonstrates no need for additional surface acreage of recreation water in rural areas for the project's service area (pages 145-149). It is not necessary to build a new reservoir to supply the facilities that are needed. The fact that recreational use of Cooper Lake would take place is not contested, but there exists the unanswered question as to what percent if any of the claimed recreational use is "new" use and not use drawn from existing reservoirs and facilities. The Institute contends that much of the flatwater recreation benefits claimed for the project are not new benefits at all and are actually use pulled from other facilities. The calculation of benefits in the Supplement is clearly in error on this count.

3. The Corps has failed to fully comprehend the requirements of Senate Document 97 and Supplement No. 1 in regard to value for hunting and fishing recreation. Judge Justice dealt with this issue and the Principles and Standards cited in his opinion vary only as to range of values. The Corps (Appendix C, pages 15, 16, 18-25, 45, 46, 49, 50) has manipulated figures from the range of values and from the Texas Parks and Wildlife Dept. for hunting but fails to justify why a particular value should be used.

DEDICATED TO WILDLIFE SINCE 1911

CORPS RESPONSE

1. The Corps recommended wildlife mitigation area (White Oak Bayou) is the most suitable from environmental, economic, and social aspects, and the Reservoir Only plan with the mitigation area is the best overall plan of the four evaluated in the supplemental EIS. This area has been concurred in by both the USFWS and TPWD as suitable mitigation for terrestrial habitat losses. Lands purchased from willing vendors, if they could be identified, would be no less expensive than the recommended area, though it is recognized that social concerns over the taking of land would be lessened. Purchases from willing vendors also, as a rule, may tend to provide scattered tracts which hinders wildlife management activities. The entire Sulphur River Basin was surveyed for suitable mitigation lands.

2. It is true that the TORP does not indicate a need for additional surface water for recreation in the rural areas for the project's recreation market area. The TORP does indicate a need for approximately 4,048 and 19,031 surface acres for 1980 and 2000, respectively, for urban areas within the market area. The TORP further states that for all planning regions (11, 12, 13, and 14) that the development of recreational water resources in close proximity to the urban areas would help to meet their needs for water oriented recreational opportunities. It should also be noted that "recreation water" in the TORP is just one activity and that just because there is no need for rural recreation water does not mean that there is no recreation need in the area and no benefits to be gained from the provision of recreation facilities in conjunction with a water resource project. There is, in fact, a need for all other recreational activities normally associated with water resource development projects. We concur that it is not necessary to construct Cooper Lake to supply recreation facilities to the area. In fact, Cooper Lake is being constructed for flood control and water supply and because of the water supply pool, Cooper Lake has potential to satisfy a portion of the recreation needs of the area. It would be an injustice to the citizens of Texas to construct a lake and not take advantage of an opportunity to provide recreation facilities. The provision of recreation facilities in conjunction with Federal water resource development project is a positive result which is not normally gained with the construction of single purpose water supply projects.

The procedure for selecting "the most similar project" includes the consideration of competing recreation resources. The per capita use curves for similar projects automatically takes into consideration competition from other lakes in the area of the similar project, since the visitation records are actual use. Figure 9, appendix D, page 151, shows the actual per capita use rate. Curves for the selected similar project under 1980 conditions are the theoretical use rate curve for the Cooper project. One can easily see that the Cooper Lake curve is significantly below the other curves which indicates that at best the recreation use and benefits for Cooper Lake are conservative. Benefits claimed in the 1974 analysis are even more conservative. According to the TORP there is a significant need for the types of recreation facilities to be provided at Cooper Lake. The need for these recreation opportunities will insure that the recreation use occurs and there is a recreation benefit because of the construction of recreation facilities which meet a portion of the recreation needs of the area. While the

COMMENTS OF WILDLIFE MANAGEMENT INSTITUTE, CONTINUED

CORPS RESPONSE

construction of recreation facilities at Cooper Lake may not be the only way to supply recreation facilities to the area, it is the only viable alternative that we know of which is currently under study and implementable. It would be nonresponsive to identified needs to administratively reduce the recreation benefit which would, in turn, lower that amount of facilities to be provided when no other alternative currently exists which would approach the level of recreation development to be provided, at Federal cost, at Cooper Lake.

3. Guidance in Supplement 1 to Senate Document No. 97 and in Principles and Standards provides for agency judgment in computing the appropriate value assigned to recreation, including fishing and hunting. A range of values is provided, however, in both documents. Judgment factors used in determination of the appropriate unit value within the range allowed are presented on pages 18-19 of appendix C. Additionally, it is the Corps position, stated throughout supporting benefit documentation in appendix C and in paragraph 3.31 of the supplemental EIS, that the correct values to be used are the high range of Supplement 1 to Senate Document No. 97. It is further demonstrated in paragraph 3.31 and tables III-7 and III-8 that any manipulations of the values used to weight fishing and hunting losses high and recreation gains low causes no change in the plan selected or in its economic justification.

4. For flood losses to livestock, an economic analysis based on local land use and management practices is used (Appendix C). Why not for fish and wildlife values?

5. It is the Institutes contention that artificial values have been arbitrarily assigned to hunting losses while non-existant values are attributed to flatwater fishing. We find that this matter has not been dealt with in a substantive manner. The Corps' analysis is superficial with little if any basis in fact. The bias in presentation of cost-benefit ratios found by the Court have not been corrected.

Page 47 of the draft SEIS contains a declaration that "the Corps does not accept, in total, the USFWS recommended downstream flow releases." This matter is discussed in Appendix B, pages 34, 38-48.

The USFWS recommended releases of 45 cfs for September-February, 50 cfs for March-April, and 30 cfs for May-August with contingency plans for drought periods.

The Corps proposes an operating plan of 5 cfs *minimum flow* supplemented by tailing off 5% of the flood pool when available at the rate of 30 cfs.

The Corps rejects the USFWS recommendations for the following reasons:

a. the USFWS matrix bears no real relationship to the existing river fishery.

b. relating acreage lost to acreage gained downstream with increased flows does not give the best indication of mitigation achieved.

c. The USFWS interpretation of life history stages data may not provide the best flow release and increased flows may not mitigate habitat losses.

d. the quality of habitat lost and current lack of access may not warrant mitigation.

e. water supply contracts now in effect limit the quantity of water available for releases.

6. It is our understanding that USFWS developed their base flow recommendations using a model developed by their instream flow group at Ft. Collins, Colorado. This model does reflect real relationships in that life history data is used. It is certainly the state of the art and provides the best available estimate as to effects of various flow regimes for the existing river channel. An attempt is made to balance all life history stages, and the USFWS acreage analysis - flow

CORPS RESPONSE

4. Economic fish and wildlife (man-day use) data for the alternatives were provided by USFWS. The methodology for calculating fish and wildlife values other than man-day use is not available. Neither the USFWS nor the Corps believes economic value of fish and wildlife should be the major factor in planning evaluations, and this information is only included for accounting of dollar benefits based on current Human Use and Economic Evaluation procedures used by USFWS. The primary values of fish and wildlife are intrinsic and intangible, and this is recognized in appendix B and in the text of the supplemental EIS in developing fish and wildlife losses and mitigation plans.

5. Values were not arbitrarily assigned. Both Supplement 1 to Senate Document No. 97 and Principles and Standards provide a range of values to be assigned to recreation (including fishing and hunting) in water resource projects. Determination of the appropriate value to be assigned within the range is documented in appendix C, pages 15-26. Data on wildlife and fisheries supply/demand for Cooper Lake were provided by USFWS, and the appropriate value was assigned by the Corps in accordance with Corps and Water Resource Council guidance. The facts on fisheries and wildlife monetary gains and losses are presented in appendix C and in the supplemental EIS in accordance with current methodology. Sensitivity analyses are presented to demonstrate that regardless of any perceived bias in the values used, there would be no difference in the plan selected by the Corps for recommendation. Monetary values for fish and wildlife have therefore received little weight in developing mitigation plans, with primary emphasis being given to their intangible value.

6. The Corps has stated its objections to certain aspects of the Incremental Method Analysis provided by USFWS, in appendix B. See also our responses to USDI comments on the aquatic analysis. To respond to this and other comments, the Corps has expanded the aquatic analysis in exhibit 1 of appendix B to more adequately describe the Corps aquatic analysis of stream impacts. Neither the USFWS nor Corps analysis and recommendation are intended to benefit one or a few species in terms of favoring the species over another. Both analyses attempt to provide an overall ecosystem balance to favor all native species of fish. The one-in-ten median year flow for the South Sulphur River, which is the most biologically critical period, was stated on page 40 of appendix B and is only 1.8 cfs in the wettest month.

rate recommendations are responsive to meeting limiting factors. There is no indication that the Corps' analysis does so, in fact, the discussion on pages 39 and 40 indicates that the Corps did not consider critical periods. What species of fish would the USFWS plan benefit most? the Corps' plan?

7. There appears to be a shortcoming in both the USFWS and Corps analysis of flow releases. The stream in question, Sulphur River, gains a major portion of its productivity/energy input from overbank flooding, a phenomenon which will be curtailed to a significant extent by the proposed project. The nature of the stream fishery will be greatly effected since overbank flooding is especially important to game fish populations in turbid alluvial streams. The Corps has failed to adequately address this issue. The USFWS plan is actually on the conservative side (minimal estimate of needed mitigation) since the USFWS plan only mitigates 45% of project induced losses due to stream channel losses. This hardly appears to be excessive. Increased flows-acreage instream may be especially needed as the fishery will rely on instream productivity to a greater extent after reservoir construction.

8. The matter of existing water contracts is of special interest as it relates to base flow releases. Such contracts should not work an estoppel on provision of the recommended base flows. They were clearly entered into by the local sponsors and the Corps at their won peril as the project was at the time enjoined for failure to comply with NEPA. It is inappropriate to foreclose options for instream flows prior to circulation of an EIS. Furthermore, the Fish and Wildlife Coordination Act mandates equal consideration of fish and wildlife resources with other project purposes and the President's Memorandum of July 12, 1978 on Environmental Quality and Water Resources Management requires Federal agencies to adequately consider the need to leave water in streams. The existing contracts do not demonstrate such consideration. Ea r USFWS recommendations were apparently ignored when contracts were developed.

9. The Corps should look at a wide range of possible alternatives for providing downstream flow needs. To this end, please add the 5 cfs low flow plus 10% flood pool to Figures 7 and 8 of Appendix B. Why is the 10% not significantly better than the 5% for instream fisheries? Also, a flow duration curve for overbank flooding for current conditions and post project conditions should be included in the final Supplement. Other alternatives for meeting the USFWS recommendations in full or to various lesser levels should be explored, i.e. allocation of water in contract by storage and use rather than elevation (if 5% cfs of flood storage is elevation is kept for low flow augmentation, a portion may be drawn off for water supply), reduction in water supply benefits reduction in flood control benefits, staged filling, more effective routing with drought prediction based on reservoir level and tank storage measurements, etc.

CORPS RESPONSE

7. Cooper Dam will prevent overbank flooding only in a decreasing scale of protection downstream to the confluence with the North Sulphur River. Overbank flooding and energy input will still occur from many small tributary streams below the dam, areas between the levees, unprotected areas, and from released floodwater. The Reservoir Only plan protects 12,900 acres of the 75,300 acre flood plain below the dam from a 30-year flood and provides no protection *beyond the North Sulphur River*. The Corps disagrees with the USFWS aquatic mitigation analysis and has presented the reasons why in appendix B.

8. Contracts for water supply in the Cooper Lake were executed in 1968, while the project was under construction (land acquisition) and prior to NEPA and the court injunction. It is true that any contract can be modified, depending on mutual agreement *between the parties involved*. The allocation of water, water rights involved, and other issues regarding protection of instream flows must be resolved before modifying the contracts would be necessary. These issues are discussed in exhibit 1 of appendix B in more detail than was included in the draft supplemental EIS, along with contract constraints for the Cooper Lake project.

9. The present wording in contracts does not make the 5 cfs minimum flow additive to the 5 percent or 10 percent flood pool releases. The 10 percent flood pool releases (50 cfs rate) increase the percent time on figures 7 and 8 in a range of 3 percent to 8 percent in most months up to a maximum of 19 percent in July. The tradeoffs for holding either the 5 percent or 10 percent flood pool are an increased risk to property and agriculture downstream, and pending *a more detailed economic or hydrologic analysis, the 5 percent flood pool manipulation is believed to constitute* the greatest acceptable risk to have more flexibility in providing for downstream flows. Stage area curves and stage frequency curves for existing and modified overflow conditions were presented in figure 1 of appendix C. Duration and acreage flooded during the historical series were presented on exhibits 1, 2, 3, 5, and 6 of appendix C. Alternatives to meeting the USFWS release and *constraints were identified in appendix B*. This appendix has now been expanded to provide more analysis of the instream flow/aquatic mitigation issue. The Corps has no authority to allocate water. The reduction in flood control or water supply benefits, except to the extent holding the 5 percent flood pool would reduce them is not warranted based on the very small economic returns to the improved fishery and the quality of the stream fishery to be inundated. Use of the 5 percent *flood* pool storage will allow future flexibility and more effective routing to optimize downstream releases. Stage filling is not recommended due to the limited benefits and economic realities of phasing construction far into the future in an inflationary economy.

10. The original Cooper Lakes and Channels Project included storage and base flow releases to maintain water quality downstream. Such water should be retained to meet instream fisheries needs rather than reallocation to other uses. Why was this not done?

The Corps' consideration of instream flow releases to mitigate impacts from reservoir construction appear token at best, certainly less than the USFWS recommended plan.

The Institute appreciates the opportunity to comment on this document.

Sincerely,

Murray T. Walton

Murray T. Walton
Southcentral Representative

MTW/ffw

CORPS RESPONSE

10. The 32,100 acre-feet of storage originally allocated for water quality purposes was reallocated to water supply storage in 1967. Water quality control was deleted as a project purpose due to assurances by the State of Texas that water quality would be maintained in accordance with standards set by the Federal Water Pollution Control Administration (now Environmental Protection Agency). The policy that storage of water in reservoirs to dilute pollutants in streams was not the most acceptable means to achieve water quality goals was further expressed by Congress in PL 92-500. EPA determines the need for water quality storage in reservoirs. The 5 cfs low flow release was determined adequate to maintain water quality in the Sulphur River, and this provision was subsequently made a part of the water storage contracts when the 32,100 acre-feet was reallocated to water supply.

SIERRA CLUB

SOUTHERN PLAINS REGIONAL CONSERVATION COMMITTEE
ARKANSAS KANSAS OKLAHOMA TEXAS

December 3, 1980

Colonel Donald Palladino,CE
U.S. Army Corps of Engineers
Fort Worth District
P.O. Box 17300
Fort Worth,Texas 76102

RE:Cooper Reservoir and Channels,Texas
Draft Supplement to FEIS

Dear Colonel Palladino:

We have reviewed the Draft Supplement to the FEIS on the above referenced project. The Sierra Club offers the following comments. We appreciate the opportunity to comment on this project, a project the Sierra Club has long had an interest.

1. The Sierra Club has long supported the alternative of a water supply reservoir for the Cooper Reservoir and Channels Project, Texas, if there was a demonstrated need established. The Draft Supplement (DS) fails to adequately establish the need for the water supply from the proposed reservoir. Population projections should be reviewed in light of the availability of 1980 census data. The DS fails to adequately document the assumptions used in projecting water requirements in the service area of the project's sponsors.

2. Your office has produced a vastly superior document compared to the FEIS. Many of our concerns appear to have been addressed.

3. We endorse the recommendations made by the Fort Worth District of the Corps and the U.S. Fish and Wildlife Service (USFWS) on acquisition of approximately 25,500 acres of land in the Sulphur River Basin for mitigation. The project sponsors would resolve much of the controversy surrounding this project by endorsing the proposed mitigation plan. The mitigation proposal is another cost of the project that should be borne by its beneficiaries. 50 percent of the Sulphur River mainstem and its major tributaries have been altered or destroyed. Construction of Cooper Reservoir would raise that figure to 72 percent. It is imperiative that the mitigation plan be concurrently implemented with other project elements.

4. The Corps proposal for minimum releases of 5 cubic feet per second (cfs) and retention of 5 percent of the flood pool is grossly inadequate. The proposed base flow should not be viewed as a mitigation proposal as the Corps would have one believe. The biological value of the river's ecosystem is less with the reservoir. The proposed 5 cfs flow will not accomplish *much except to provide* a little more flow during the summer. The Corps has failed to develop a mitigation plan for this aspect. And while retention of 5 percent of the flood pool is beneficial, these releases would occur anyway-their timing is

"When we try to pick out anything by itself, we find it hitched to everything else in the universe." John Muir

CORPS RESPONSE

1. In response to this and other comments, *the water supply needs study* is now included as exhibit 2, *appendix D. This study* was completed in April 1980 prior to availability of any 1980 census estimates. At this writing, 1980 census data available are still preliminary. For comparison, however, preliminary 1980 Bureau of Census *estimates for* populations of *several cities* included in the water supply needs studies were obtained. These preliminary estimates for the city of Irving are 109,575 versus an estimate (1977) used in the needs study of 105,100. For Sulphur Springs, the preliminary 1980 *census estimate* was 12,809 versus 15,900 used in the needs study (1978 estimate), and for Cooper 2,325 versus 2,000, respectively. For the city of Commerce, preliminary 1980 estimates were 8,038 compared to 9,200 in the needs study. These preliminary estimates *do not* appear to discredit any basic assumptions made in the study *based on* available population estimates. Water requirement projections were made based on past trends in growth of water use per capita. Population *projections* were based on disaggregation of OBERS Series E projections used in Federal water resource studies, with projections for Collin, Rockwall, and Hopkins Counties being modified upward based on recent *rapid growth* in those counties. Base year use rates and projections were derived from actual water pumped by the suppliers to derive a per capita use rate. Documentation of all assumptions made is now available for review in exhibit 2, appendix D.

2. Noted.

3. Noted. The terrestrial habitat mitigation plan will be implemented as practicable considering the construction status of the project *and* the need for Congressional authorization. The Corps will act in accordance with the Congressional *decision on* the recommended mitigation plan. The cost of the proposed mitigation plan will be shared by the water supply sponsors.

4. The proposed flow by the USFWS (30-45-50 cfs) can only be viewed as a mitigation flow, since it is not developed from the base flow hydrology or ecological makeup of the Sulphur River and is *not a* proposed minimum flow. It is an *optimum* theoretical continuous flow developed by USFWS to minimize potential impacts to the life stages of 10 indicator species. It is not a base flow, since the Sulphur River at the damsite experiences fluctuations in flow ranging from almost 33,000 cfs to 0 cfs, and continuous daily discharges of 30-45-50 cfs occur a very small percentage of the time under natural conditions. The Corps position remains that the biological value of the stream downstream of the dam will be sustained with the 5 cfs minimum release, and flow will be augmented beneficially in most years with manipulation of the 5 percent flood pool storage. The Corps has developed an aquatic mitigation plan in the form of a lake fishery which will increase habitat significantly for 50 percent or more of the species currently existing in the river segments inundated, the flow release schedule utilizing the 5 percent flood pool, tailwater stream fishery, and public access to all stream reaches within lands acquired for the project.

irrelevant if an adequate minimum base flow is not established.

5. Water supply contracts for the reservoir's yield have been generally defined by elevation. This forecloses alternative ways of obtaining unused water in the conservation pool or any of the water in the sediment pool for release of adequate minimum base flows. We suggest the Fort Worth District of the Corps initiate contract modifications so that actual quantities of water are specified (e.g., acre-feet). If water requiring a water rights permit is identified, then the Corps should obtain the permit on the grounds that it is a project purpose to provide water for resources held in the public trust.

6. The Corps has failed to adequately demonstrate that staged filling is not feasible. Slightly less than one-half of the firm annual yield will be used by the 20 year target date. Water could be impounded above the Stage I elevation for the purposes of providing downstream releases on an interim basis.

We support the recommendations of the USF&WS which requests monthly releases of 50-45-30 cfs which represents the optimum flow for the downstream areas.

Please include these comments as part of the public record.

Sincerely yours,

Howard Saxion

Howard Saxion, Chairman
Southern Plains Regional
Conservation Committee Sierra
Club

P.O. Box 8069
Dallas, Texas 75205

CORPS RESPONSE

5. Neither the Corps, nor the Federal Government, has authority to allocate water or control use. Storage space for water supply can be provided in Federal projects, and that storage has a determined yield. The authority to designate who uses water stored in a Federal project has always been with the State involved, including provision for leaving unallocated water in streams. The Corps will not obtain a water rights permit, and based on our analysis of state water law, the obtaining of a water right for instream uses may require specific legislation initiated by the State. See also exhibit 1 of appendix B.

6. At March 1980 price levels, a stage I Cooper Lake providing about 60 mgd dependable yield would have a direct construction cost of $81,832,000 if constructed to allow for ultimate impoundment and operation at the design pool presented for the Reservoir Only plan. This compares to $88,267,000 for the unstaged reservoir recommended in the supplemental EIS. For the second stage of construction, an additional $8,772,000 in construction costs would be incurred, primarily to modify the stage I dam and clear additional areas within the stage II pool. While the total March 1980 costs for a staged project are only $2,400,000 more in direct construction costs, this does not take into account 20 years of inflation on the estimated $8,772,000 in stage II construction costs. The benefits to be gained from a staged project are a temporary postponement in wildlife habitat inundation and a rejuvenation of the reservoir fishery after a period of natural aging. If storage above the stage I pool were used to make interim downstream fishery releases, some of the benefits to terrestrial habitat would be foregone, and the shoreline would have a larger fluctuation zone which would hinder recreation use.

TEXAS COMMITTEE ON NATURAL RESOURCES
4144 COCHRAN CHAPEL ROAD
DALLAS, TEXAS 75209
(214) 352-8370

CORPS RESPONSE

December 10, 1980

Col. Donald J. Palladino
District Engineer
P.O. Box 17300
Fort Worth, Tx 76102

Re: Cooper Dam and Channels

Dear Sir:

Enclosed are our initial comments on your Draft Supplemental Environmental Statement.

Because of the voluminous contents of the DSES, the short time to comment, and the fact that governmental agencies with expertise have not yet completed their comments for our inspection, we request an extension of thirty days to make additional comments.

Sincerely,

Edward C. Fritz

Edward C. Fritz
Chairman

ECF:mak

An extension of time to 31 December 1980 was granted by letter dated 19 December 1980.

COMMENTS ON DRAFT SUPPLEMENTAL ENVIRONMENTAL STATEMENT
COOPER DAM AND CHANNELS, TEXAS
BY TEXAS COMMITTEE ON NATURAL RESOURCES

[illegible]

	Paragraph	Comment
1.	1.04	The Draft Supplemental Environmental Statement(DSES) says that the habitat mitigation proposal will cost more to the local sponsors, and is controversial. Yet the DSES never discusses the possibility of [illegible] for construction of the dam until the local sponsors agree to pay their share of mitigation costs. NEPA requires such a discussion.
2.		In the absence of obtaining a commitment by local sponsors to pay their share of land acquisition costs for habitat mitigation, the Army Corps has failed to comply with the Fish and Wildlife Coordination Act.
3.	1.05	The DSES fails to present adequate back-up information to substantiate the purported need.
4.	1.06	The DSES says, "the implementation of the recommended mitigation plan is an unresolved issue." After issuing the DSES, the Army Corps held a public hearing November 24, 1980, at which the local interests stated that they did not want to pay for mitigation. The Army Corps has already contracted with them to build the dam without requiring a local sharing of habitat mitigation costs. The DSES fails to present a plan to provide habitat mitigation without local sharing of costs. It cannot be delayed until after the final supplemental Environmental Statement(FSES).
5.	1.14	The DSES states that the Selected Plan would reduce the flood hazard on 12,900 acres of land, while inundating 19,305 acres and periodically inundating another 3,435 acres. The DSES fails to show how few days of flooding might be saved compared to how many days of inundations would be caused by the reservoir. Such a comparison is vital to evaluate the alternatives dollarwise, as well as otherwise. It also fails to account for the rest of the 27,494 acres which the reservoir would inundate(S.E. p.52)
6	Table II-1 (pg 12)	The DSES fails to provide methodology and data to support its net needs conclusions. The percentage of savings is shown to decrease. This is contrary to reasonable projections of increasing water conservation practices.
7.	3.10	The DSES states an undocumented and unquantified conclusion that recreation use is low because of private ownership and limited access to streams. We have observed considerable usage, not only where public roads cross the river, but also on private land along the river. The Army Corps should quantify present usage before FSES.
8	3.15	The DSES says that the [illegible] of a water supply lake would be different [illegible] the [illegible] differences.

[illegible]

1. The three local water supply sponsors for the reservoir are required to pay all costs of the project allocated to water supply. The [illegible] the recommended mitigation features will be allocated to project purposes in the same proportion as other project costs, and the local sponsors will be required to reimburse the Federal government accordingly for their share of the allocated mitigation costs. The signed water supply contracts will be supplemented if necessary to insure reimbursement to the Federal government in accordance with current [illegible] requirement prior to construction.

2. The local sponsors will be required to pay their share of [illegible] mitigation costs.

3. The water supply needs study is now published as exhibit [illegible] appendix [illegible] to the supplemental EIS as back-up data for the [illegible] needs. It is clear from this study that by the year [illegible] will be in excess of the 109 mgd yield of Cooper Lake.

4. The NTMWD presented a statement at the public meeting on 24 November 1980 that they felt placing the burden on local sponsors of paying for mitigation was unfair. However, the NTMWD statement also expressed their assurance that they would pay their fair share of the project costs. The other local sponsors did not make statements at the public meeting but have assurances on file that they will reimburse the Federal government for cost allocated to water supply, including the appropriate share of the mitigation cost.

5. It is correct that the Reservoir Only plan will provide flood protection up to a 30-year event for about 12,900 acres of agricultural lands located downstream of the dam. Under normal operating conditions the reservoir is expected to inundate up to 22,740 acres, of which only 3,435 acres is dedicated for flood storage purposes. The remaining 19,305 acres is to be used for water supply storage. Thus, the lands afforded protection are considerably greater than those inundated for this purpose. In terms of inundation-acre-days, a gross analysis was made using only the cleared and semiwooded flood plain land uses for which damage reduction benefits were calculated. Data on these lands flooded and the historical series of flood events and durations (1945-1971) with and without the reservoir in place are found as exhibits [illegible] and 6 of appendix C. If inundation-acre-days/year are represented as the total acres of agricultural lands flooded (excluding wooded) X the total days of duration of flooding ÷ the 27 years of record, then the status quo condition averages 100,387,292 inundation-acre-days/year. After the reservoir is in place, the flood plain would continue to suffer an average 69,560,108 inundation-acre-days/year. Applying the same analysis to the 3,435 acre flood pool, it was determined that a maximum of 20,250 acres were flooded for a duration of 335 days, during hypothetical operation of the project using the 1945-1971 period of record. This results in a corresponding inundation-acre-days/year average of [illegible],250. The average inundation-acre-days/year prevented by the project are therefore 100,387,292 - 69,560,108 - [illegible] = 30,[illegible]. In effect, this is saying that approximately [illegible] inundation-acre-days/year in the flood pool result in [illegible] inundation-acre-days/year prevented downstream. The Corps, however, does not recognize this type of analysis as an accepted methodology for evaluating flood control aspects of Federal projects.

The benefit-cost and social-economic analyses take into account the total losses in agricultural lands needed for all project purposes, not just flood control. These figures were compared to lands to be protected with the reservoir in operation. As noted in table III-6, page 40, the estimated net gain in agricultural production is $28 million. The 27,394 acres shown on page 32 (not 52) refers to the maximum design water surface for the Water Supply Only alternative. Comparatively, the maximum design water surface for the multiple purpose reservoir is 26,563 acres. Difference is these two acreage figures is due to the differences in operating characteristics of a water supply lake and multipurpose reservoir. Because the Water Supply Only reservoir would be constructed without provisions for flood control, dam outlets would provide pass-through of flood flows up to the standard project flood frequency event. In the rare event of a maximum probable storm selected as the design criteria for the safety of the dam, the outlets could not release **all the** flood flow. An additional 5,419 acres could be inundated. Appendix D, pages 18-20, presents pertinent data for the multiple purpose reservoir.

6. Net needs methodology and data are supported in the Water Supply Needs Study which has been published as exhibit 2 of appendix D. There are several reasons for the decreasing percentage of savings attributable to conservation. First, in the baseline projections, the trend in industrial water use reflects increasing recirculation of water. Therefore, the projection of these trends automatically reflects conservation. This has the effect of decreasing the baseline *net needs over the years. For municipal use, it is assumed that all* new construction and all replacement plumbing will be required to use water saving devices. After several years a majority of the existing plumbing fixtures will have been replaced, and so continuation of a conservation program would mean that most of the savings would be from new construction. This means there is a diminishing return effect on the with-conservation net needs.

7. According to the TORP, 1975, State Summary Volume, page 68, the demand for recreation on rivers and streams often remains unsatisfied for three reasons: (a) access is limited and Texas Waterways have not been developed to readily accommodate recreational use, (b) opposition to the recreational use of waterways by landowners whose property could be jeopardized by large numbers of recreationists passing near their land, (c) confusion and misunderstanding on the part of both landowners and recreationists as to the definition of public waterways and subsequent conflicts over individual rights. Because of extreme fluctuations in water levels, the South Sulphur River does not maintain a desirable flow for canoeing, kayaking or rafting. Because of the lack of dependable flow and access, the general recreation use on the river is insignificant. We believe that most of the existing use is sport fishing and hunting and this use has been quantified by the U.S. Fish and Wildlife Service.

CORPS RESPONSE

8. The hydraulic design differences between a multipurpose lake and a water supply only lake at the Cooper site can be seen in the following table summarized from pertinent data included in appendix D.

	Elevation (feet msl)		Area (acres)		Capacity (acre-feet)		Spillway Discharge (cfs)	
	WS	MP	WS	MP	WS	MP	WS	MP
Top of Conservation Pool	440	440	19305	19305	310000	310000	-	3000
Top of Flood Control Pool	-	446.2	-	22740	-	441400	-	3000
Guide Taking Line	445	451.2	22075	25595	414288	-	-	81472
Maximum Design Water Surface	454.3	452.8	27494	26563	646244	603670	157000	159320
Top of Dam	459.8	458.5	-	-	-	-	-	-

WS - Water Supply Only
MP - Multipurpose

The Water Supply Only alternative would require the purchase of 22,075 acres of land. The water supply pool would inundate approximately 19,305 acres of land, since floodwaters are only allowed to pass directly through the lake, an additional 5,419 acres of land could be inundated should the flood be of a very large frequency. On the other hand, the multipurpose project would require the purchase of 25,595 acres of land. The normal level of water in this plan would also inundate 19,305 acres of land. This reservoir has the capacity of holding floodwaters of a 30-year frequency flood and releasing them at a regulated rate. If this is the case, an additional 3,435 acres could be periodically inundated. If the frequency is greater than 30-year, the maximum water surface level would inundate 26,563 acres of land. In addition to these differences, the water supply lake has outlet works which consist of a 5-foot diameter conduit and the multipurpose project outlet works consist of four 6-foot by 6-foot sluices, one in each gate pier. The spillways also differ. The Water Supply Only project has a 275-foot uncontrolled concrete ogee service spillway and a 4,200-foot emergency spillway. The multipurpose project has a 200-foot concrete ogee service spillway controlled by five 40-foot by 20-foot gates and a 4,200-foot emergency spillway.

In summary, the main operating difference between a water supply reservoir and a multiple purpose reservoir with flood storage space occurs

COMMENTS BY TEXAS COMMITTEE ON NATURAL RESOURCES, CONTINUED

CORPS RESPONSE

during periods when a flood occurs above the dam. A water supply reservoir passes floodwater when the lake reaches its spillway elevation. With a multiple purpose lake, floodwaters are temporarily captured above the conservation pool and released at a nondamaging downstream rate. *The time of retention varies with the magnitude of the flood captured* (1-58 days for the multiple purpose Cooper Lake). Operation for water supply and effects on downstream flows during nonflood stages are identical for both types of lakes. Impacts of flood storage and downstream releases of a multiple purpose reservoir as opposed to the Water Supply Only alternative are quantified in Section V of the supplemental EIS.

(2)

9. 3.16 The DSES says that 68 existing or potential surface sources were eliminated due to no available yield, distance, or no comparative advantages. We challenge the elimination of many of these. The Army Corps conclusions are vague, self-serving and undocumented.

10. 3.16 The DSES dismisses ground water alternatives with no quantification, based solely on conclusion of Texas Department of Water Resources, refered to, but not specifically quoted in the DSES. The DSES fails even to cite the quantities available, the costs involved and the extent of encroachment and iron and fluoride, in the available groundwaters. The DSES also fails to discuss what measures might be taken to make the available groundwater acceptable for consumption, how much it would cost, and whether or not such measures are to be taken regardless of whether the dam is built.

11. 3.16 The DSES dismisses recycling of return flows on the basis of broad, unquantified conclusions that they "could not be used directly for general municipal and industrial uses unless the effluents were treated to drinking water standards." Why couldn't they? What about specific municipal uses such as lawn watering, and industrial uses such as cooling? What about the return flow after purification on land treatment?

12. 3.16 The DSES fails to quantify the standard of treatment which would be required, and the costs thereof.

13. 3.16 The DSES fails to describe or quantify the social concern over reuse before primary treatment, and after each such stage. Reuse at various stages is increasing, nationwide, with less and less social concern.

14. 3.16 The DSES fails to discuss a program of reduction of usage, such as rationing for lawn sprinkling, and many other conservation measures.

15. 3.16 The DSES fails to discuss the long range situation, in which water conservation will be necessary, regardless of construction of the dam.

16. 3.17 The DSES continually bases its discussion on the assumed requirement of 103 mgd, although it never adequately demonstrated that this quantity will be essential.

17. 3.18 The DSES admits the viability of Cooper relying on Lake Sulphur Springs for its water supply, but dismisses this alternative on the mere word of city officials that they don't want to continue that arrangement, and that the pipeline and pumping facilities are temporary. The Corps fails to discuss the possibilities for making those arrangements and facilities permanent, and for expanding them in the future.

18. 3.18 The DSES refers to "future peak demands in Cooper," without quantifying them. Without providing surplus water now, the Army Corps can reduce the possibility of increasing peak demands in the future.

19. 3.18 The DSES rejects an alternative because it would "disperse" environmental impacts. Why wouldn't dispersed impacts be preferable to imposing heavier impacts on a single area?

CORPS RESPONSE

9. The elimination of the 68 existing or potential surface sources for no available yield, distance, or no comparative advantages is justified. Tables 12 through 15 in appendix D have been expanded to give a more specific reason for their elimination.

10. Groundwater was dismissed as a water supply alternative based on the Texas Department of Water Resources (TDWR) report "Groundwater Resources of the Cooper Lake and Channels Project Area." This study was completed at the Fort Worth District's request and responds to the question as to whether groundwater resources would be sufficient to meet all or a significant part of the needs. The following summary gives the quantities available, an approximation of the costs involved, and the extent of iron and fluoride content in the water. The TDWR report is now included as exhibit 3 of appendix D.

Trinity Group

The Trinity Group Aquifer is composed of the Twin Mountains Formation and the Paluxy Formation. The Twin Mountains Formation produces about 90 percent of the water in the Trinity Group measured and reported yields in this formation range from 10 to 1,900 gallons per minute (gpm) with the average being 286 gpm. In the mid- and late 1970's, maximum depths of water levels were measured at 210 to 562 feet in Collin County and from 434 to 992 feet in Dallas County. From 1955 to 1975, the water level has declined from 200 to 275 feet in Collin County and from 197 to 508 feet in Dallas County. Groundwater quality of the aquifer was checked and it was determined that in the Twin Mountains Formation of 111 fluoride determinations 75 percent were above the Environmental Protection Agency (EPA) and Texas State Health Department (TSHD) safe drinking water standards maximum allowable level of 1.6 milligrams per liter (mg/l). Also, approximately 19 percent of the 57 iron determinations were above the maximum allowable level of 0.3 mg/l. There has also been some saline water encroachment that is evident in Dallas County. It will continue as long as current pumping levels are sustained.

The Paluxy Formation supplies the other 10 percent of the water from the Trinity Group Aquifer. The yields of wells in this formation range from 10 to 482 gpm with an average yield of 97 gpm. In the mid- and late 1970's, the maximum water depths were 316 to 583 feet in Collin County, 401 to 500 feet in Dallas County, 444 feet in Hunt County, 331 feet in Rockwall County, 223 feet in Kaufman County, and 190 feet in Delta County. In the period 1955 to 1975 water levels declined 130 to 300 feet. The water quality of this formation is similar to the quality of the Twin Mountains Formation. Approximately 32 percent of the 77 fluoride determinations exceed the EPA-TSHD maximum allowable level. Approximately 31 iron determinations were made and 13 percent were above the maximum allowable level of 0.3 mg/l.

Carrizo-Wilcox

The Carrizo-Wilcox is the other major aquifer in the study area. It is composed of the Wilcox Group and the Carrizo Sand. Records of wells and springs indicate that the aquifer is near full and rejecting recharge usable quality water is found at maximum depth of 600 to 700 feet in the southeastern corner of Hopkins County. Wells in northwestern Wood County yield 50 to 450 gpm based on measured and reported yields. In Franklin and Wood Counties some water levels occur at or above the land surface and so flow at 1 to 25 gpm. In other areas, the water levels occur at 10 to 100 feet below the surface. From 1951 to 1977, water level records indicate a decline of 5.5 feet due to pumpage in the Winnsboro area. Tests in the Department's Groundwater Quality Monitoring Program indicate high concentration of iron in Wood County with some as high as 2.2 mg/l and 67 percent of the determinations above the EPA-TSHD standards. Only one of the PH determinations in the aquifer was below 7.0, but a representative analyses in comparable areas of Wood County indicate approximately 50 percent of the PH determinations are below 7.0.

Woodbine

The Woodbine is one of the minor aquifers in the study area. The measured and reported yields range from 50 to 740 gpm. The maximum depth for water in this aquifer is 2,100 feet. During the mid- to late 1970's, the maximum depths to water levels were 540 feet in Dallas County, 526 feet in Collin County, 450 feet in Hunt County, and 305 feet in Kaufman County. From 1955 to 1975 water level declines ranged from 10 to 204 feet in Dallas County, 50 to 100 feet in Collin County, 50 to 100 feet in Hunt County, and 40 to 50 feet in Kaufman County. These declines indicate serious overdrafts of the aquifer. In Dallas and Collin Counties, in some cases, water would have to be lifted more than 600 feet. Groundwater in this aquifer also has high concentrations of iron and fluoride. Of 232 fluoride determinations, 66 percent exceeded 1.6 mg/l which is the EPA-TSHD maximum allowable concentration. Of the 97 determinations for iron, 35 percent were above EPA-TSHD maximum allowable level.

Nacatoch

The Nacatoch Aquifer is the other minor aquifer in the study area. Usable water depths range from 400 to 620 feet in Dallas County, 70 to 652 feet in Hunt County, and 40 to 300 feet in Kaufman County. Wells in the Nacatoch Aquifer have measured and reported yields ranging from 125 to 254 gpm in Delta County, 20 to 335 gpm in Hunt County, and 40 to 100 gpm in Kaufman County. Water level data in Hunt County indicate that maximum water level declines were probably about 190 to 200 feet from 1914 to 1971. Groundwater quality is similar to the other aquifers in the area. About 17 percent of the 23 fluoride determinations in Delta and Hunt Counties exceed the EPA-TSHD maximum allowable level of 1.6 mg/l.

Future Development

Additional development of these aquifers will cause some economic and water quality problems such as extreme pumping lifts, acute water level declines, some saline water encroachment, and undesirable concentrations of iron and fluoride. The approximate annual yield in mgd's through the year 2090 are as follows for the aquifers.

Trinity Group	11.6
Carrizo-Wilcox	2.2
Woodbine	3.9
Nacatoch	0.4
Total	18.1

In 1978, pumpage from the aquifers in the Cooper area was approximately 15 mgd. There has been an overall decrease in groundwater usage over the past few years. This leaves very little for future supply.

Costs for a properly constructed and equipped well could cost as much as $300 per foot at 1980 prices. In addition, PH and iron treatment, if there is a treatment plant in place that could be used, would cost approximately $0.05 per thousand gallons. The cost for fluoride treatment would also be approximately $0.05 per thousand gallons. The cost of transmission and storage would range from $0.15 to $0.20 per thousand gallons. Land values in the Cooper area are approximately $450 per acre. This would be much too costly, especially considering the limited quantities available. While the rural areas will continue to depend on groundwater as a source of supply, it is not a dependable long term source of supply for municipalities.

11. A municipal water supply is distributed through one transmission system. To distribute water that did not meet drinking water standards would require a separate transmission system. Separate transmission systems are used in some communities, one for drinking water and another for reclaimed wastewater. Due to the cost of such systems, however, the use of two systems is generally restricted to areas where water supplies are extremely scarce, and the demand for both drinking water and reclaimed wastewater are high. Another alternative would be the construction of a water treatment plant next to the sewage treatment plant which would also be costly. Industries can, after receiving the proper permits, utilize water other than that meeting drinking water standards. This, however, would be at their own discretion. Return flows after typical land treatment would not meet drinking water standards either and would also require a separate transmission system to distribute the water.

12. The standard of treatment required for the water before distributing it would be the same as it is now as specified by State and Federal water quality standards. The source of raw water for a water treatment plant

in this case would be the sewage outfall from the wastewater treatment plant. The TSHD must provide a permit for the raw water intake of a water treatment plant and they currently have never permitted a sewage outfall as a raw water supply. The cost of purification would be dependent upon the quality of water at the sewage outfall. It should also be noted that under normal operating conditions when the sewage effluent is released into streams and rivers, it undergoes a natural purification process which is free until it reaches the raw water intake for the water treatment plant.

13. There has been strong opposition to the use of reclaimed wastewater as a source of supply. One place where they currently have two separate systems is in Southern California. At first there was opposition, but the system was accepted after installation. This is believed mainly due to the extremely severe shortage of water in that area. There would be large social concern over such reuse of water if there was another acceptable alternative as is the case with Cooper Lake.

14. Conservation methods are discussed starting on page 21 in the Cooper Lake Water Supply Needs Study which is attached as exhibit 2 of appendix D.

15. The Cooper Lake Water Supply Needs Study discusses conservation methods and how they can be implemented over a period of years. It gives the effects of these conservation methods but points out that permanent measures of conservation leave less flexibility for water supply when a drought occurs.

16. The need for water is clearly demonstrated in the Cooper Lake Water Supply Study. Even the net needs with conservation considered are greater than 109 mgd. The NTMWD in their letter of 20 June 1980 state that their projected needs, alone, will be approximately 105 mgd by 1985. This letter is exhibit 1 of appendix D. There is a need for more than 109 mgd and this is clearly demonstrated in the Corps Water Supply Needs Study.

17. Currently facilities for supplying Cooper with water from Lake Sulphur Springs only have the capacity of supplying 0.25 mgd. This is less than the need for Cooper will be by 1985 with conservation methods implemented. Lake Sulphur Springs can supply water in sufficient quantities to meet both the needs of Sulphur Springs and the needs of Cooper, but by 2040 there will be a need for another source of supply. The needs of Cooper and Sulphur Springs are not as immediate nor as great as the needs of NTMWD and the city of Irving. The needs of Cooper and Sulphur Springs with conservation considered comprise less than 1 percent of the total conservation needs. There is still a need for Cooper Lake based on the needs of NTMWD and the city of Irving.

18. By 1985, the with conservation needs for Cooper are projected to be 0.37 mgd. The existing pipeline from Lake Sulphur Springs will only

handle an average of 0.25 mgd and, therefore, would be insufficient in supplying Cooper with its needed water. We interpret this to say that by not providing a dependable source of water supply, the projected needs will not occur. These needs are based on population projections and per capita municipal use rate. The population projections were based on a disaggregation of OBERS Series "I" projections with Collin, Rockwall, and Hopkins Counties modified upward to account for recent trends in rapid growth. The needs justify the project. The project does not justify the needs. This projected growth cannot be ignored in our study.

19. Consolidated impacts would have several advantages over having dispersed impacts. First, the New Bonham area has slightly higher quality habitat due to its location near the Red River and, therefore, would be more detrimental to the environment than building a lake at the Cooper site. Secondly, there is an interbasin transfer of water that would occur with the construction of New Bonham Lake which would increase flows to the Trinity River system. This could also cause potential aquatic impacts with the higher salinity water from the Red River being transported into a tributary creek of Lake Lavon. There are also some terrestrial and aquatic losses that will occur with shallower pool levels and different site locations. It is the opinion of the Corps of Engineers, which is supported by published data from the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department, that the most significant wildlife habitat impacted by reservoir projects is bottomland or flood plain forest. Any reservoir built for water supply purposes, no matter how small, will have its major wildlife habitat impact on bottomland forest. Two reservoirs will generally inundate more of this significant habitat type.

(3)

Paragraph		Comment
20.	3.21	The DSES considers floodproofing "existing fences, levees, roads, bridges and houses," but does not pinpoint which ones for "two houses on Highway 37," which one can assume are the two which are closest to the river.
21.	3.22	The DSES claims it has a Comprehensive Non-Structural Flood Damage Reduction Plan. Later, all pages 65 to 93, there are some elements of a plan, to put into effect without further information. The DSES offers *nothing on the non-structural level that approaches the structural plan* already prepared and operable.
22.	3.22	The DSES refers to a 24,200 acre corridor for public acquisition, but does not explain why it would be necessary to acquire the entire 24,280 acres, nor to acquire more than a recreation easement, nor to acquire any more than some scattered parks, and does not describe the varying features along the corridor, to aid in selecting certain portions.
23.	3.22	The DSES refers to nine parks along the river, but does not locate them precisely, nor state their separate costs, nor state why these nine were selected, nor describes their features.
24.	3.22	The DSES does not consider a less expensive non-structural plan which would have an even higher benefit/cost ratio than the favorable 1.6 found for the expensive one(p.38 and Appendix D, page 93). An increase to 1.8 would surpass the selected plan.
25.	3.22	The DSES coes not present enough detail to show why the Army Corps would reasonably reject the non-structural approach in favor of its long-desired structural plan.
26.	3.22	The DSES discusses a non-structural approach which requires supplemental feeding, but not rotation of pastures, the present practice. It does not show why the cost of *supplemental feeding* could not be reduced by the combination of rotating pastures when floods inundate some pastures.
27.	3.22	The DSES refers to technical assistance, but not to educational practices, an important feature of a non-structural approach.
28.	3.22	The DSES rejects a non-structural plus water supply lake plan on the contentions that the two "plans" are separate, and the Corps could not fully implement either. These are not lawful grounds for rejection.
29.	Table III-6 pp38-40	The DSES fails to discuss the ecological values of the sites which would be lost or saved under different alternatives, for example, the loss of nutmeg hickory-oak plant association. The DSES also fails to discuss the advantage of the non-structural approach being by far the least costly.
30.	3.29	The DSES rules out a local sponsor for the non-structural approach on the basis of a mere phone contact with the staff of only one agency. Local sponsorship would be more likely if the Army Corps ruled out the selected plan of federally subsidizing the construction of a huge dam.
31.	3.31	The DSES fails to quantify and consider ecological losses, other than in fishing and hunting.

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20. The two houses in question are on State Highway 37. These two frame houses are south of the river on opposite sides of the highway from each other and are the two habitable structures closest to the river on State Highway 37. This portion of the report was an overview of nonstructural approaches rather than a detailed description of the Comprehensive Nonstructural plan. Floodproofing of structures other than houses was not included in the Comprehensive Nonstructural plan. Damage reduction benefits to fences and floodproofing benefits to *residences* are discussed in detail on pages 59-62 of appendix C.

21. The Corps does in fact have a Comprehensive Nonstructural plan. Section 3.22 describes the plan elements. Further section IV of appendix D elaborates on the Comprehensive Nonstructural plan. The Comprehensive *Nonstructural plan has been given equal consideration* in evaluation and plan selection.

22. It is not necessary to acquire a 24,200 acre corridor to develop the recreation aspects of a nonstructural alternative. An incrementally justified recreation plan could be developed for many alternatives with varying amounts of land and scales of recreation development. This 24,200 acre recreation corridor concept was selected because it encompassed all the river meanders and allowed for a continuous greenbelt in the flood plain between the upper limits of the study area and Wright Patman Lake.

23. The recreation aspects of the nonstructural alternative are discussed in greater detail in section IV of appendix D, pages 84-92. In this section, additional information is provided on the plan of recreation development, the lands required for this development, and the costs and benefits associated with the proposed development. The approximately 2,625 acres of park development are within the 24,200 acre corridor and therefore are not specifically located except by *road crossing or river mile*. The specific location and limits of these areas would be determined during field reconnaissance for the master plan should the alternative be selected.

24. It is inferred from this comment that a lowering of the costs of the nonstructural plan could *result in a benefit/cost ratio of* 1.8 as opposed to the 1.6 determined by the Corps. Even if the nonstructural plan had a benefit/cost ratio of 1.8 due to lowering of costs, the excess benefits would still not come close to approaching those of the Reservoir Only plan, nor would the nonstructural plan by itself resolve one of the major identified needs of water supply.

25. There were several reasons for not selecting the nonstructural plan in comparison to selection of the structural plan: (1) the benefit/cost ratio was lower for the nonstructural plan than the structural plan; (2) the excess benefits were substantially less for the nonstructural plan ($379,200) as compared to the tentatively selected plan ($2,041,800); (3) while the nonstructural plan does

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accomplish flood control and recreation, it does not provide for water supply; and (4) the nonstructural plan is not as implementable as the structural plan because it is dependent on the willingness of landowners to voluntarily implement portions of the plan. All of the above reasons are found in the text of the report.

26. The nonstructural plan does not require supplemental feeding. The plan calls for removal of cattle within the 30-year flood plain which in itself rules out any supplemental feeding of cattle. The benefits of the nonstructural plan were compared to the without project condition which considered cattle operation within the 30-year flood plain. The damages of the without project had as a basis the cost of supplemental feeding.

27. Education and technical assistance are very much the same in a plan which requires individual flood plain landowner action to reduce flood damages. We agree, education is an important element of a nonstructural plan.

28. The Corps does not reject a plan on the basis that the plan is not implementable either partially or fully by the Corps. Implementability was not the main reason for rejection of the Comprehensive Nonstructural plan. It is, however, required that any problems with the plan are to be discussed and, in our view, implementability is a problem with the nonstructural approach. Further, we are required to select the plan that is in the best overall public interest. The Reservoir Only plan is the best plan, primarily because of the greater net excess benefits and the fact that it more fully accomplishes all project purposes as compared to the Water Supply Only, Comprehensive Nonstructural, or the Combination Water Supply and Nonstructural plan developed in appendix D. The Reservoir Only plan is also better economically and has less environmental and social impact than the Reservoir and Levees plan.

29. Plant associations impacted are discussed in paragraph 4.05, page 55, and fish and wildlife in paragraph 4.04, page 54. These associations are fairly uniform within the flood plain, though quality increases in a downstream direction based on joint agency HEP evaluations. The plant and animal associations present were documented in detail in biological inventories published in the draft EIS of June 1976 and incorporated by reference into this supplement. Ecological values lost as related to fish and wildlife habitat, wetlands, air, water, and noise pollution are discussed in table V-1 for each alternative. The most significant ecological association impacted is the flood plain, or bottomland hardwood forest which does include some nutmeg hickory, a species not abundant anywhere, but found throughout the Southeastern United States, including Oklahoma and Arkansas. Quantification of these losses is made throughout the supplemental EIS and mitigation for bottomland hardwood losses is included for all alternatives as an evaluation factor. The Comprehensive Nonstructural plan is presented as the least costly plan in table III-6 of the supplemental EIS and reasons for rejection, even

though it is the least costly, are found in paragraph 3.31, page 41, of the supplemental EIS and in section VI of appendix D.

30. With an annual cost of $549,000 (table 33, section IV, appendix D, page 89), it is highly unlikely that a local sponsor, other than the Texas Parks and Wildlife Department (TPWD), could be found with the financial resources to undertake such an obligation in the Sulphur River Basin. Recreation development on some Texas rivers, such as the Guadalupe, has been undertaken by TPWD, and the larger River Authorities such as in the Brazos or Colorado River basins have also shown some support of river recreation. The provision of recreation development in association with an economically justified Federal water resource project provides another vehicle to provide much needed recreation facilities.

31. Quantification **is made** in section V of the supplemental EIS for losses of various habitat types used by wildlife, stream losses, wetlands, and the quality of air and water. These are all ecological impacts. Effects of temporary flooding on tree species, and direct and indirect impacts on these ecological factors are included in equal detail for all four alternatives in section V and summarized for evaluation and comparison in section III of the supplemental EIS.

(4)

	Paragraph	Comment
32.	3.31	The DSES fail to account for the huge differences among the alternatives of inundation acre-days under reservoinr and under occassional floods.
33.	Table III-8	The DSES here gives the non-structural approach a 1.1 benefit/cost ratio, contrasting with 1.6 on Table III-6. There is no showing of how much this would increase if less dollars were spent on acquisiton of land and actively altering the habitat to provide more deer and squirrels, instead of just plants which grow naturally.
34.	3.32	The DSES continues to consider the potential of 120,000 acre feet in Wright Patman Lake as a beneficial impact of Cooper Dam, in spite of the Army Corps insistence that no decision has been made to reallocate flood stoeage to Wright Patman Lake. *The Army Corps is trying to have its cake and eat it...* to consider benefits of a potential action without yet preparing an environmental impact statement citing the harmful impacr of that action.
35.	3.32	The DSES lists monetarily wildlife losses at only $17,200. This obviously omits all the benefits that wildlife provide to the ecosystem other *than for hunting and fishing.*
36.	3.32	The DSES claims that the non-structural approach would reduce agriculture land in the three-year flood plain. *There is no showing* of why a reduction would be necessary.
37.	3.32	The DSES claims that the non-structural approach would remove 24,200 acres from public ownership. There is no showing such lands would be removed.
38.	3.32	The DSES claims that lands would be converted to hay production and 2400 acres would be cleared, under the non-structural approach. There is no adequate proof of these claims.
39.	3.33	The DSES states that the non-structural plan is "the worst in terms of losses in agricultural productivity, tax revenues, and property value." Such losses are not adequately demonstrated.
40.	3.35	Here, again, the DSES claims the benefit of conversion of 120,00 acre feet *of flood control storage in Wright Patman DAm* to water supply, but fails to consider *the more than offsetting enfironmental* impact of such conversion.
41.	3.35	The DSES admits that the nonstructural approach could cause "fewer and less sever" environmental impacts, but never adequately describes and quantifies them.
42.	3.36	The DSES rejects full mitigation, and settles for acquisition of only a part of the USFWS recommended acreage in White Oak Creek. The ARmy Corps withholds the fact that easements on so e or all, of the White Oak Creek lands would have to be acquired, anyhow, to accommodate waters when the projected expansion of Wright Patman Lake takes place.

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32. See response to comment 5. The term "inundation-acre-days" we believe should represent the flood damage reduction objective of the alternatives. Not considering the water supply pool, which does not contribute to the flood control purpose, the number of acre-days/year the land is flooded in the flood pool of the multiple purpose reservoir is far less than the number of acre-days/year protected from flooding downstream. The Water Supply Only alternative and the Comprehensive Nonstructural plan cause no change in inundation-acre-days, except those lands currently flooded within the water supply pool would no longer suffer periodic damages as they would be permanently inundated.

33. Table III-8 in the supplemental EIS provides an assumed economic analysis of the four plans using Principles and Standards values in lieu of values from Supplement 1 to *Senate Document 97*. As explained in paragraph 3.31, page 41, the analysis uses the lowest allowable values for lake oriented recreation and the highest values for losses/gains of hunting and stream fishing. This assumed analysis demonstrates that the structural plans are still better economically even if full weight is given to losses of known natural fish and wildlife monetary values and the minimum benefits are claimed for lake recreation gains. In the *Comprehensive Nonstructural* plan presented, credit is given for potential monetary benefits to wildlife production increases on the full 66,200 acres of land in the 3-year flood plain which is assumed to increase in habitat value through a natural succession process with voluntary land use change. There is no cost associated with these successional changes. Using data from table 37 in appendix D, a comparison can be made of the Comprehensive Nonstructural plan with and without the recreation corridor, which is the major cost of the plan. Modified average annual charges without acquisition and recreation features would be $81,600 and average annual benefits for flood damage reduction and potential wildlife (man-day use) increases would be $227,200, for a benefit/cost ratio of 2.8. However, net annual excess benefits would only be $145,600 compared to $379,200 for the Comprehensive Nonstructural plan presented. No benefits for public general recreation would be possible without public acquisition and facilities. If only the eight park areas (2,625 acres) were acquired and developed, and the remainder of the 24,200 acre corridor was left in private ownership, the 530,000 general recreation days would be provided and the modified average annual charges for this plan (again from modification of data in tables 33 and 37 of appendix D) would be reduced to about $565,900 from $630,600 for the Comprehensive Nonstructural plan presented. Benefits would remain the same and the benefit/cost ratio would increase to 2.1. However, net excess benefits (the average annual dollar return on the investment) would still be far less than the Reservoir Only plan ($525,500 vs $2,041,800). In addition, with this modified plan the use of the remaining 21,575 acre corridor down the South Sulphur and Sulphur Rivers as a trail system by the public would not be possible and public development or active habitat management of lands other than at the eight parks could not occur. The Comprehensive Nonstructural plan presented in the

supplement is, therefore, still considered the best overall nonstructural plan even though other modified plans with less land acquisition may have a higher benefit/cost ratio.

34. The rationale for the storage exchange benefits is explained on page 53 of appendix C. It is granted that these benefits are potential in nature, but they represent a legitimate economic impact which could occur as a result of construction of Cooper Lake. The exchange of storage space (and resultant economic benefits) is attributable to Cooper Lake construction and cannot be accomplished without Cooper Lake. The fact that the benefits are "potential" is no different than many other benefit categories, but given that the projection of the future with the project is reasonable and probable actions will actually occur, these benefits are legitimate. It should be noted also that the $113,000 annual benefits claimed for storage exchange constitute only 2.2 percent of the benefits for the Reservoir Only plan and deleting these entirely would have no significant economic bearing on plan selection.

35. Correct. Man-day use analysis of fish and wildlife impacts has been included in the draft supplement as furnished by the U.S. Fish and Wildlife Service and concurred in by the Corps. Monetary values were assigned for recreational use and commercial trapping and fishery value. The nonmonetary and largely unquantifiable ecological value was the primary consideration in developing mitigation plans and recommending acquisition, development, and management of wildlife habitat mitigation areas even though there are few tangible monetary benefits.

36. The Comprehensive Nonstructural plan recommends that farming and grazing practices be removed from the 3-year flood plain since economic analysis shows that this flooding frequency causes agricultural pursuits within this zone to be uneconomical without structural protection from flooding. Since the zoning is voluntary, it would be up to the landowner to continue or abandon agricultural pursuits in full cognizance of the hazard. By removing the cattle from the 3-year flood plain, fences can be removed and damages to the cattle grazing activity can be reduced. Furthermore, more intensive agricultural uses inside the 3-year flood plain may promote stream pollution by farm chemicals and sedimentation. A benefit of this reduction would be enhancement of wildlife habitat inside the 3-year flood plain.

37. The word "public" ownership has been corrected to "private" ownership. In the event the recreation feature of the nonstructural plan was implemented this would require the acquisition of 24,200 acres of flood plain lands which are now in private ownership. As yet, there is no sponsor interested in this plan. However, the recreation feature was incorporated into the plan to accomplish one of the project purposes which is recreation.

38. The first word on page 45 of paragraph 3.32 should have been semi-wooded rather than wooded. Secondly, note on page 35, paragraph 3.22, that the "...... plan is basically a voluntary land use plan," and

thirdly note on page 80 of appendix D that the assumption was made that 80 percent or 2,400 acres of the 3,000 acres in semiwooded land in the cultivated zone would be cleared and converted to hay production. It is granted that these are assumptions made by the Corps to credit benefits to the voluntary portions of the plan.

39. A uniform method of analysis was used to evaluate all plans to determine gains and losses. The Social Economic Impact Assessment, appendix D, pages 115-136, describes the anticipated impacts from the investigated plans and methodology used. The Comprehensive Nonstructural plan causes the greatest loss of tax revenues. Paragraph 3.31 incorrectly stated that this plan was also the worst in terms of agricultural productivity losses and net property value loss. The Water Supply Only plan is the worst in these two categories and paragraph 3.31 has been corrected accordingly.

40. The rationale for the storage exchange benefits is explained on page 53 of appendix C and discussed in comment 34 above. The environmental impact of the conversion, beneficial and adverse, will be included in an EIS when the conversion is proposed. Whether adverse environmental impacts will offset benefits to increased water supply will not be known until analyses are conducted. It should be noted that the storage exchange benefits claimed for Cooper Lake are for flood control and no benefits are claimed for water supply increases, expected increases to the Wright Patman fishery, or other categories, which must be considered when the actual conversion is proposed.

41. Quantification of environmental, social and economic impacts of the Comprehensive Nonstructural plan is at the same level of detail presented for the other three plans and the no action alternative in accordance with CEQ regulations implementing NEPA. The level of detail presented is adequate to make a reasoned choice between alternatives, which is the purpose of an environmental statement. The statement is intended to be analytic, rather than providing detailed information having little bearing on decision making.

42. Easements are in effect on about 75 percent of the 33,380 acres of compensation land recommended by the U.S. Fish and Wildlife Service (USFWS) in their August 19, 1980, Planning Aid Letter. No new easement lands are required to accommodate the future proposed storage conversion at Wright Patman, as the project was designed to accommodate a future conservation pool raise. Some additional interest in lands already acquired, however, may be necessary to accommodate the new level. None of the acreage proposed for mitigation (USFWS proposed or Corps recommended) is within areas which would be inundated by the Wright Patman Lake pool raise. The Corps modified the USFWS recommended plan, in accordance with action agency authorities in the Fish and Wildlife Coordination Act, to acquire only lands currently under flowage easement. This reduces cost significantly and also minimizes social-economic impacts related to relocations of people, structures, and loss of productive agricultural land.

(5)

	Paragraph	Comment
43.	3.36	The DSES nowhere adequately describes and supports the rationale for rejecting the U.S. Fish an d Wildlife Service recommendations on downstream releases. Contrary to Corpsconclusions, USFWS has identified stream losses as a result of the dam. The Corps cannot evade mitigation merely by the semantics of the term, "optimum releases."
44.	5.02	The DSES admits that 641 acres of downstream wooded areas would be flooded by dam releases for longer periods thanin a natural state, and gives the days for the worst-ease situation. But nowhere are the total acre-days of such inundation, and of reservoir inundation, reflected in in the BSES.
45.	5.03	The DSES fails to explain why a reservoir without levees would necessarily have the same specifications as a reservoir with levees.
46.	5 05b&c	Here again the DSES fails to consider a non-structural approach without a conversion of semiwooded habitat to bottomland and open ha itat.
47.	5.06b	The DSES states that "farm structures" will suffer flood damage under a no-action alternative, but does not identify or locate such structures. We challenge the existence of valuable farm structures in the 30-year floodplain.
48.	5.06b	The DSES predicts that in the absence of an Army Corps project, the water supply lake would be built by local interests. If so, why should the federal taxpayers be required to subsidize it? What loss of water supply will occur if the Army Corps rejects the federal project? The Army Corps fails to consider the conflict between this action and its claims, elsewhere, that the federal project is needed for water supply.
49.	6.06	The DSES substantially rejects the USFWS recommendations for downstream flow without discussiong wuch basic issues as the public trust doctrine--that flows adequate for protecting stream and estuarine ecosystems, including fish and wildlife resources, should be clearly recognized as a responsible and beneficial use of water and should receive the highest degree of protection from the State as public trustee. The DSES is therefore grossly deficient.
50.	Appendix B	The DSES fails to take congnizance of intermediaryflow schedules, of the inadequacy of 5 cubic feet per second to compensate for upstream losses, of the necessity to provide habitat for life stages which require more water in order to maintain certain native species, of the difference in importance between a spring, fish and a mature fish of the necessity to mitigate for the life of the project, of the great difference in value between a natural ecosystem like Horton Bottom and a managed area such as the DSES selects for mitigation.
51.	Appendix C	The DSES fails to recognize that the cattle are totated from pasture to pasture, so that the inundation of one pasture for a relatively short period during a flood will not cause much of an outright loss, if any, in the carrying power of a farm.
52.		The DSES fails to recognize that herds must be rotated, regardless of whether or not floods occur.
53.		The DSES fails to consider the reduction in timber losses which could be

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43. Appendix B to the supplemental EIS presents rationale for rejection of USFWS recommended optimum flows. The Corps also recognizes stream losses to inundation throughout appropriate sections of the supplemental EIS and appendix B. The Corps also recognizes the aquatic habitat gained in the lake, and presents a justified aquatic mitigation plan based on the USFWS recommendations and Corps analysis of overall social, environmental, economic, and institutional feasibility. This is in accordance with action agency responsibilities defined in the Fish and Wildlife Coordination Act. The USFWS recognizes that their downstream recommendations constitute optimum releases. Their analysis by the incremental method indicated optimum releases would only mitigate 45 percent of the inundated stream aquatic habitat. The Corps has expressed its comments and reservations on accepting the results of the methodology used in appendix B.

44. The total number of days this 641 acres would be inundated in the worst case condition would be the full 335 days during the period of record (1945-1971) that the reservoir would be expected to be in flood stage (above 440.0 feet msl). This averages 12 days per year over the 27 year record by hypothetical operation. Without the project, overbank flooding occurred a total of 1,197 days (at the Hagansport gage) or an avera[illegible] 44 days per year. Reservoir inundation-acre-days/year for the [illegible]ol were addressed in comment 5.

[illegible]ervoir was optimally sized to provide authorized flood [illegible](30-year), storage for water supply, and a reserve for se[illegible] flood storage in the reservoir provides flood protection (at [illegible]rees depending on intervening drainage between the dam and a point [illegible]stream) to about 12,900 acres of land. The levees and channels in the Reservoir and Levees plan would function to provide full 30-year protection in areas partially protected by the reservoir by raising some levees and by constructing new levees to foster agricultural development (intensification). The reservoir provides no significant flood protection downstream of the confluence of the North and South Sulphur Rivers where the majority of levee work was proposed in the Reservoir and Levees plan. This levee and channel system (3RS and 4RS) was proposed essentially as local protection and functions separately of Cooper Reservoir. Total protection with the Reservoir and Levees plan was 24,300 acres, and due to intervening drainage below the dam, Cooper Lake by itself, no matter what size, could not provide this level of protection below the North Sulphur confluence.

46. You should note paragraph 5.05b that 9,900 acres of cleared and semiwooded land within the 3-year flood plain will revert to bottomland hardwood habitat while only 2,400 acres of semiwooded land will be converted to hay production. The net result of the Comprehensive Non-structural plan is a significant improvement in wildlife habitat quality and quantity, while at the same time providing economic benefits to landowners.

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47. Data on known farm structures in the flood plain were included on page 83 of appendix D and page 61 of appendix C. Photographs of these seven structures and the two residences are on file in the Fort Worth District office. Damages to these structures will occur in the no action condition, although it is noted in the referenced pages above that annual damages are small. The major structural damage category is fencing. We did not use the term "valuable" to describe farm structures in the flood plain. As noted in the supplemental EIS, these structures are fairly old and their estimated total value is $33,000.

48. If the Reservoir Only plan is not built by the Corps, it is likely that the local interests will develop the surface water supply yield of the Sulphur River at some future date. The most likely Water Supply Only project would be a lake at the Cooper site. There are other benefits to be derived from the multipurpose project other than water supply benefits. There are benefits for flood protection, recreation, and fish and wildlife that are also derived from the multipurpose project. The multipurpose project will better utilize available resources, is a better overall project, and will provide more benefits than the Water Supply Only reservoir.

49. More information on what flows the Corps believes constitute instream protection downstream and mitigation flows are now included in exhibit 1 of appendix B. The protection of instream flow uses is within the State's authority and beneficial uses of water (including instream uses) are a part of the Texas Water Code. Legal and Federal policy analysis of the instream flow issue is now included in exhibit 1 of appendix B.

50. The Corps does recognize the intermediary flow schedules presented by the USFWS, the loss of stream productivity due to inundation, and the necessity to provide water downstream of the dam for native fish. The Corps analysis and interpretation of downstream flows required to protect or mitigate for aquatic losses is now presented in more detail in exhibit 1 of appendix B. There are few truly natural ecosystems in the Sulphur River basin, including Horton Bottom. To compensate for wildlife habitat losses, land must be managed. A managed wildlife habitat will have far greater value for most species than the area in its present condition (White Oak Bayou).

51. Flood damages and flood reduction benefits claimed were based on the management practices occurring in the project area. The methodology used to estimate these potential benefits is described in detail in appendix C, pages 3 to 8.

52. The potential economic return of pastureland is reduced when the flood plain pastureland is not available due to flooding.

53. Timber harvesting was noted to occur in the flood plain (appendix C, page 35). These activities are limited and any flood damages would be minimal. Accordingly, no benefits were claimed for reduction of timber losses.

Paragraph		Comment
	Appendix C (cont.)	effectuated merely by not stacking logs in the floodplain during usual flooding season.
54.		The DSES fails to recognize that clearing has occurred mainly in periods of high expectation of a federal subsidy in reducing floods, and therefore such clearing cannot be relied upon as establishing a trend if the flood control project is not constructed.
55.		The DSES bases its prognosis of intensification on self-serving speculation.
56.		The DSES gives assurance of a future EIS prior to implementing conversion of 120,000 acre feet of Wright Patman to water supply. But once Cooper Dam was constructed big enough to provide that conversion, most of the damage would be done, so the second EIS would be of little value.
57.		The DSES calculated the water supply benefits on the basis of "the cost of the most likely alterntive", and then poses the same reservoir (only built without federal aid) as the most likely alternative. This is sheer sophistry.
58.		If the Corps is to resort to the cost of an alternative to bolster its benefits, it should at least use the least expensive and least environmentally damaging alternative, which would be a smaller dam, or, preferably, a comprehensive use reduction, waste reduction, and recycling program.
59.		The Corps fails to evaluate adequately the benefits of a program which would involve lesser growth and lesser inducement of new industry. The local sponsors are promoting the project for the express purpose of attracting greater development and new industry.
60.		The DSES fails to reveal how much of the purported agricultrual benefits would occur on the property of one or a very few, landowners.
61.		The DSES fails to explain its economic conclusions adequately for comprehension.
62.	Appendix D	The treatment of water conservation is superficial. The estimates of possible savings are grossly inadequate.
63.		The DSES fails to discuss specifics about most of the reservoirs which might be used as alternative sources of supply. It shows that distances of some potential sources are closer than the Cooper Dam, and does not explain adequately why they were eliminated. It passes off many under vague arguments like "relatively low yield" or "are too far from potential users." It fails to discuss using one rejected dam for Irving and another for the Sulphur River area and another for NTMWD. It fails to show how much of the existing yield of each potential source is already in use, what are the projections, how computed, and what are the costs of buying the water. It fails to compare site-specific environmental impacts among reservoirs and potential reservoirs, merely saying such self-serving conclusions as that the adverse effects of damming a short creek would be "similar" to damming the Sulphur River. It fails to compare the acres inundated in quantity and quality. It fails to compare a smaller Cooper reservoir.
64.		The DSES fails to present non-structural plan ready to be implemented as an alternative to the implementable structural plan. It makes a big obstacle out of the reltive novelty of the non-structural approach without offering any specific program to show the public the benefits of that approach. It exaggerates the problem of obtaining acceptance to a non-structural approach, thereby helping to kill that approach.

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54. Pages 11 and 12 of appendix C point out that in recent years clearing of flood plain lands below the proposed damsite has occurred primarily because of the expectation of flood protection that would be afforded by the project. Intensification benefits were claimed in the 1974 analysis and are more supportable in the latest analyses. Predicted changes in land use such as from woodland to pasture, or pasture to crop, produce greater economic return. Intensification benefits creditable to flood control provisions are that portion of increased income from the new land use which is a direct result of the flood protection. Such benefits would not be expected in the future if the project is not completed. Accordingly, the changes in land use that have occurred help confirm the trend toward higher utilization of the flood plain lands assuming adequate flood protection is provided.

55. The procedures followed in developing the agricultural benefits claimed are described in appendix C, pages 11 and 12, for the 1974 analysis, and pages 80 to 82 for the 1980 analysis. As part of the recent 1980 evaluations, detailed land use maps were prepared and onsite interviews were made with agricultural interests in the affected study area. These data sources substantiated the likely changes which could reasonably be anticipated with the recommended project in operation.

56. The building of Cooper Dam has nothing to do with the damages caused by the future storage conversion at Wright Patman. No lands will be inundated at Wright Patman until an EIS on this action is prepared. Cooper Dam will only make the conversion possible.

57. It has long been Corps procedure to base the water supply benefits on the basis of the cost of the most likely alternative. The procedures for this are outlined in the Water Resources Council Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resources Planning (Level C) (18 CFR Part 713). The least expensive and least environmentally damaging alternative is a lake at the Cooper site as outlined in appendix D, section III.

58. As outlined in appendix D, section III, the least expensive and least environmentally damaging alternative is the full size (109 mgd yield) lake at the Cooper site. Procedures for calculating the benefits are referenced in the previous response.

59. The water supply analysis took into account both existing needs and projected future needs for the region based upon normal growth. Unconstrained future needs were modified (reduced) to reflect possible implementation of various conservation programs (appendix D, page 31). The social-economic impact analysis determined that the project would permit net beneficial desirable local growth. Excess capacity for inducement of industry was not included. It is possible that some local sponsors are interested in promoting industrial development, however, such considerations were not incorporated into the water supply analysis.

COMMENTS BY TEXAS COMMITTEE ON NATURAL RESOURCES, CONTINUED

CORPS RESPONSE

60. The exact number of landowners has not been determined. However, it is known flood protection will be provided to a number of smaller landowners as well as to several large holdings.

61. The benefits were developed following accepted procedures. These procedures were applied in a consistent manner to insure comparability and also compliance to Federal and agency regulations.

62. Water conservation is discussed in exhibit 2 of appendix D. Savings that are attributed to conservation methods are based on Water Conservation Devices, Residential Water Conservation by the U.S. Department of Interior, Office of Water Research and Technology;

63. The elimination of the existing reservoirs from the water supply study is now explained more fully in tables 12 through 15 in appendix D.

64. The nonstructural measures which constitute the plan are listed in paragraph 3.22 of the supplemental EIS and are all fully implementable. Even the recreation plan is implementable with a sponsor or by local or State agencies. The Corps has stated the challenges involved in nonstructural planning for an agricultural area. It was felt that the reader should be informed about these challenges and difficulties inherent in nonstructural planning and the Corps responded to these challenges in a positive manner. In fact, to increase our objectivity in formulating a nonstructural plan, a prominent consultant in the field of nonstructural planning was obtained to lend his experience in the development of this Comprehensive Nonstructural plan. Finally, the Corps did show the public benefits to be derived from a nonstructural approach in paragraph 3.22 and the text throughout section IV of appendix D, which describes in detail benefits which can be expected to accrue with the Comprehensive Nonstructural plan.

(2)

Paragraph		Comment	Corps Response
65.	Appendix D (cont.)	The DEIS states that soybeans are a less lucrative crop than pasture and timber and yet claims the plurality of the agricultural benefits from the selected project for protection of soybeans and for conversion from timber.	65. The 1974 analysis for the nonstructural plan did point out the potential farm income from soybeans was less lucrative than pasture and timber (appendix D, page 78). This discussion has been rephrased slightly to reflect flood threats. The purpose of this analysis was to identify activities which could be economically viable for flood plain landowners while allowing flooding of these lands to continue. In general, it was found that timber had a low damage potential. Similarly, flood plain lands committed to pasture were found profitable regardless of the flood threat. The nonstructural plan does not control flooding; it only proposes land use change to reduce damages and increase net income compatible with the flood threat. In the case of the Reservoir Only plan, the 1974 analysis of flood benefits was based upon damage reduction and conversions to pasture and row crops with structural flood protection provided. This is explained on pages 36-43 of appendix C. With structural protection, agricultural conversions from timber become much more economically viable. In the 1980 analysis for the Reservoir Only plan, some conversions to higher valued crops were included in the benefit analysis (page 81 of appendix C) as supported by the 1980 land use study.
66.		The DEIS does not adequately explain why floods would cause so much damage to hay crops and cattle production, in view of the fact that some types of hay withstand considerable flooding and that cattle are retreated to higher land in flood times.	66. The procedures used to estimate damages for the nonstructural alternative were documented in appendix C and are explained on pages 57 and 59 for the 1974 price levels. The benefits assignable to the nonstructural plan are based on reduced flood losses which in turn would permit more optimal use of the affected flood plain lands.
67.		At page 88, the DEIS poses a highly expensive recreation plan in which the Texas Parks and Wildlife Department Staff personnel indicated no interest; and yet fails to present an alternative recreation plan, such as could be run by the county or private interests.	67. This was addressed in comment 30. It is true that a county or private interest may develop recreation areas at their own desire and expense along the Sulphur River. This has not occurred to any significant degree in the past, and an alternative involving purely local interests to develop enough recreation facilities to meet identified demands is unlikely to be implemented.

Texas Committee on Natural Resources adopts also the comments of Wildlife Management Institute on the DEIS.

CORPS RESPONSE

December 13, 1980

Donald J. Palladino, Colonel CE
District Engineer, Department of the Army
Fort Worth District, Corps of Engineers
P. O. Box 1730
Fort Worth, Texas 76102

Dear Colonel Palladino:

The League of Women Voters of Plano would like to offer the following comments on the draft supplement to the final enviormnmental impact statement (EIS) of October, 1980.

Our organization has a long record of study and action on the national, state and local levels relating to water quality and water supply. At the national level we support "planning and management of water resources to meet regional needs and the national interest". We also support NEPA of 1969 as well as FWPCA of 1972 and the subsequent amendments. At the state level our position is one of support for "comprehensive long range state water planning with emphasis on enhancement of water quality, conservation and re-use of water and development of water supplies by ecologically and financially sound means...."

Our long standing interest in water matters prompted our local League to sponsor a public meeting in Plano on August 28, 1980, to provide citizen information on the Cooper Reservoir project. As a result of that informational update and a study of the draft document we want the Corps of Engineers to know that the League of Women Voters of Plano support the revised project which includes deleting 27 additional miles of previously authorized levee work, and 35 miles of authorized channels downstream from Cooper Reservoir. We also support the proposed increase of mitigation acreage to 25,500 as we believe it is necessary to preserve adequate natural areas in rapidly developing districts such as Northeast Texas. It is difficult to project population increases for our area but we all realize increases will occur. Subsequently, we believe the Cooper Reservoir project must go forward with these proposed improvements to provide both adequate water supply and also protect natural areas in our part of Texas.

Noted.

We would have appreciated more detailed information than was provided in the draft on the numerous alternative supply sources

included in the first draft, which were elemenated from this draft. We do not believe, however, that such deficiencies in this draft warrant any further delay in the project.

We urge the various governmental entities affected by the project to encourage more conservation and re-use of both our current and future water supply in all our communities to provide a better margin of safe supply for the coming decades.

We commend the Corps of Engineers for the increased mitigation acreage and concur that growth is imminent for this area and we must move forward now to provide adequate water.

Sincerely yours,

Meg Titus

Meg Titus
President, League of Women
Voters of Plano
3330 San Gabriel Dr.
Plano, Texas 75074

MT/mv

CC: City of Plano City Manager
League of Women Voters of Texas
League of Women Voters of United States
Diana Clark, President LWV-T

CORPS RESPONSE

More information on potential sources of water has been included in the final supplemental EIS in response to comments by the Texas Committee on National Resources. The Water Supply Needs Study has also been published in appendix D to present more data on projected needs and water use assumptions made by the Corps.

Noted.

Noted.

Sulphur River Heritage Society
1[illegible] [illegible] St.
Commerce, Texas 7542[illegible]
November 29, 19[illegible]

Colonel [illegible] Palladino
District Engineer
U.S. Army Engineer District, Ft. Worth
Corps of Engineers
P. O. Box [illegible]
Ft. Worth, Texas [illegible]

Dear Colonel Palladino: Re: Cooper Lake and Channels

Thank you for a draft copy of the Cooper Lake and Channels Supplemental Environmental Statement, and for the opportunity to comment on it.

a. Environmentally, the Reservoir Only plan is clearly superior to the Reservoir and Levees plan. The loss or degradation of [illegible],400 acres of terrestial wildlife habitat as compared to the loss of [illegible] acres in the earlier plan makes the Reservoir Only plan preferable. Also, because of the deletion of unneeded channels and levees, the public will acquire needed water for a first cost of $[illegible] million, as compared to $[illegible].6 million.

b. The acquisition and management of 25,500 acres of wildlife mitigation land is a welcome feature of the Reservoir Only plan. The fate of the Cooper Lake project should Congress fail to fund this land acquisition is, however, a disturbing prospect; disturbing to all interested parties, of no matter what persuasion.

c. That the entire proposed acreage of mitigation lands is situated in the White Oak Creek area some sixty miles downstream from the dam, and far from Delta, Hunt, and Hopkins Counties, is disappointing. Hunters, naturalists, campers, and hikers from these counties need woodlands closer to home. Some of the mitigation lands could come from woodlands, that will remain unflooded, adjacent to the lake.

The Sulphur River Heritage Society is a group of some fifty citizens, mostly residing in Commerce and adjacent areas of Hopkins and Delta counties. While recognizing our need for water, especially in Delta County, the group is concerned that this need not be satisfied at too

CORPS RESPONSE

Noted.

The Corps recognized the uncertainty and unresolved nature of the land acquisition portion of the mitigation plan in the draft supplemental EIS. We are pursuing authorization of the White Oak Bayou mitigation area. Should changes be required in the mitigation recommendations, or authorization and funding not be forthcoming, the Corps will reevaluate the recommended plan and coordinate accordingly before beginning physical construction.

Approximately 10,000 acres of land above the conservation pool at Cooper Lake will be publically available for these activities. About 7,000 acres will be designated for wildlife and low density public uses such as hunting, birdwatching, or hiking, and about 3,300 acres will be designated for existing and future developed recreational use. About 3,000 acres of woodland will be available adjacent to Cooper Lake on these lands, and open areas will be revegetated.

CORPS RESPONSE

-2-

high a cost, economically, aesthetically, or environmentally.

On behalf of the Sulphur River Heritage Society,

Sincerely,

Anthony J. Buckley

Anthony J. Buckley

Noted.

Alvin W. Wingo
Route #1 - Box 124
Autumn Trail
Forney, Texas 75126
December 10, 1980

TO: Donald Palladino, District Engineer
DEPARTMENT OF THE ARMY
FORT WORTH DISTPICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102

As a hunter of public lands and a buyer of metroplex water, I've viewed with concern the potential loss of 29,000 acres of public lands due to the Cooper Dam.

It is my understanding the Supplemental Environmental Impact Statement calls for 26,000 acres of mitigating lands with deletion of channels and levies. I also understand part of the cost will be borne by users of water from the impoundment. I support the mitigation land and am more than willing to pay my share of the cost.

Alvin W. Wingo

CORPS RESPONSE

The Cooper Lake Project will inundate and cause the loss of 19,000 acres of private lands. Approximately 7,000 acres of perimeter lands will be made available for public hunting at the Cooper Lake Project where formerly there was no public hunting.

Noted.

R.F. Oakley
7817 El Pensador
Dallas, TX 75248

Dec 8, 1980

Donald Palladino, District Engineer
Ft. Worth Corps of Engineers
Box 17300
Ft. Worth, TX 76102

subject: Cooper Dam Project

Dear Mr. Palladino:

For many years we have utilized the Cooper Dam project Lands for bird hunting. When the dam is closed, this excellent wildlife habitat will be Lost to the public.

Unlike most states, Texas has very Little public Lands open to sportsmen for hunting. The Corps of Engineers provides much of the Limited Lands available to us.

We support the plan in the Suplemental Environmental Impact Statement which includes a wildlife mitigation plan for 26,000 acres, and deletion of channels and Levies.

CORPS RESPONSE

Private lands were acquired for authorized purposes of water supply, flood control, and recreation, including fishing and hunting. They have been available for public use in the interim since construction of the dam was delayed. After completion of the dam, about 7,000 acres of perimeter land will remain available for public hunting.

Noted.

We are willing, even eager, to pay our share of the additional cost. We can no longer afford the exhorbitant prices for private hunting leases.

If there is to be a public meeting on this subject please let us know. We do want to attend.

Sincerely,

R. J. Oakley

CC: TIBHA

CORPS RESPONSE

Noted.

A public meeting was held in Sulphur Springs on 24 November 1980.

Crowder Construction Company
3702 Astoria
Arlington, Texas 76013

Mr. Donald Palladino
Department of the Army
Fort Worth District, Corps of Engineers
P.O. Box 17300
Fort Worth, Texas, 76102

Dear Sir,

I am a member of the Texas Independent Bird Hunters Association, Inc. and am writing to you about the Cooper Dam Project. The possibility of a public hunting area in conjunction with this project would be a welcomed decision.

The availibility of public land on which to hunt is being depleted everyday as evidenced by your 29,000 acre project and numerous other areas in the state. We, as hunters, need all the public land that we can get since the majority of us can't afford to own our own land and the cost to lease hunting land is out of sight.

I hope that you will take into consideration the needs of several thousand hunters in this immediate area that would use such public hunting land and see fit to allow a public hunting area.

Respectfully yours,

G.T. Crowder

CORPS RESPONSE

Noted.

The Cooper Lake Project will inundate and cause the loss of 19,000 acres of private lands. Approximately 7,000 acres of perimeter lands will be available for public hunting and to the mitigation area if authorized.

Noted. Public hunting will be allowed on perimeter project lands and the mitigation area.

6.11 Statement Recipients - Final Supplemental EIS.

a. Congressional

Honorable Lloyd M. Bentsen, United States Senator
Honorable John G. Tower, United States Senator
Honorable Ralph Hall, House of Representatives
Honorable Sam B. Hall, House of Representatives
Honorable Martin Frost, House of Representatives

b. Federal

US Department of the Interior, Office of Environmental Project Review
Heritage Conservation and Recreation Service
US Fish and Wildlife Service (Regional Directors, Area Offices, and Field Offices)
Environmental Protection Agency (Regional and Washington, DC)
US Department of Commerce, Deputy Assistant Secretary for Environmental Affairs
US Department of Commerce (Component Agencies)
US Department of Agriculture (Component Agencies)
US Department of Transportation (Division Engineer and US Coast Guard)
US Geological Survey
Public Health Service
Federal Energy Administration
Federal Energy Regulatory Commission
US Department of Housing and Urban Development
Advisory Council on Historic Preservation (Denver and Washington, DC)
US Department of Justice, US Attorney
Water and Power Resources Service
Oakridge National Lab

c. State

Office of the Governor of Texas, Budget and Planning Office (individual copies to State agencies)
Louisiana Department of Public Works, Director
State Clearinghouse, State of Arkansas

d. Environmental

Texas Committee on Natural Resources
National Audubon Society, Library
National Audubon Society, Southwestern Regional Office, Regional Representative
National Audubon Society, Field Research Director
National Audubon Society, Director of Audubon Sanctuaries
ARK-LA-TEX Group, Sierra Club, Shreveport
National Wildlife Federation, Washington, DC
Sportsmen's Clubs of Texas, Austin, Texas
Wildlife Management Institute, Washington, DC

Wildlife Management Institute, Field Representative
(Murray Walton)
The Conservation Foundation
Environmental Defense Fund
Texas League of Women Voters
League of Women Voters of Arkansas
The Coalition on American Rivers
Arkansas Wildlife Federation, Inc.
Sierra Club, Lone Star Chapter
Texas Conservation Council, Inc.
Ozark Society, Bayou Chapter
Ozark Sierra Club
Sierra Club, Conservation Committee
Dallas County Audubon Society
Texas Independent Bird Hunter's Association

e. Others

Arkansas Planning Commission
ARK-TEX Council of Governments
North Central Texas Council of Governments
Texoma Regional Planning Commission
East Texas Council of Governments
Red River Valley Association, Director
Red River Valley Association, Vice President
Sulphur River Municipal Water District, President
North Texas Municipal Water District, Executive Director
North Texas Municipal Water District (attorney for)
Texas Committee on Natural Resources (attorney for)
Levee District No. 1, Red River County (attorney for)
University of Texas, Dr. Clark Hubbs, Witness for Plaintiff
Chamber of Commerce, Texarkana, Executive Vice President
Director of Public Works, Irving, Texas
Chamber of Commerce, Delta County, President
Southern Methodist University, Dr. Alan Skinner, Research
Archeologist
East Texas State University, Library
Southern Methodist University, Library
Northeast Texas Economic Development District
Lake Texarkana Water Supply Corporation
Miller County Drainage and Improvement District
City of Irving, Texas, Mayor
City of Irving, Texas, President, Chamber of Commerce
City of Cooper, Texas, Mayor
City of Cooper, Texas, President, Chamber of Commerce
City of Commerce, Texas, Mayor
City of Commerce, Texas, President, Chamber of Commerce
City of Sulphur Springs, Texas, Mayor
City of Sulphur Springs, Texas, President, Chamber of Commerce
City of Texarkana, Ark-Tex, Mayor
City of Texarkana, Ark-Tex, President, Chamber of Commerce
Chamber of Commerce, East Texas
Board of County Commissioners, Bowie County, Chairman
Board of County Commissioners, Camp County, Chairman

Board of County Commissioners, Cass County, Chairman
Board of County Commissioners, Delta County, Chairman
Board of County Commissioners, Fannin County, Chairman
Board of County Commissioners, Franklin County, Chairman
Board of County Commissioners, Hopkins County, Chairman
Board of County Commissioners, Hunt County, Chairman
Board of County Commissioners, Lamar County, Chairman
Board of County Commissioners, Morris County, Chairman
Board of County Commissioners, Rains County, Chairman
Board of County Commissioners, Red River County, Chairman
Board of County Commissioners, Titus County, Chairman
Board of County Commissioners, Wood County, Chairman
Miller County, County Judge
Texas Archeological Society, Dallas, Texas
Atlanta Times
The Commerce Citizen
The Dallas Morning News
News-Telegram, Sulphur Springs
Cooper Review
Paris News
Texarkana Gazette
Commerce Journal
Mr. B. A. Lemser
Mr. John Gay
Mr. N. K. Malone
Mr. John Waddell
Mr. E. H. Ingram
Mr. Doug Blackburn
Mr. Jim Spillman
Mr. P. Thomas Mann
Mr. Taylor Dillard
Ms. Virginia Tschanz
Ms. Frankie Farrar Holden
Dr. H. Paul Friesema
Mr. C. M. Waters
Mr. Lynn Chapman
Mr. Don Abernathy
Ms. Meg Titus (League of Women Voters)
Mr. Joe Blackwell
Vinson and Elkins, Attorneys at Law
Mr. Robert V. Bartlett
Mr. Bruce McNeil
Mr. Jack Elliot
Mr. G. T. Crowder
Mr. R. F. Oakley
Mr. Alvin Wingo

f. Libraries

Texarkana Public Library
Camp County Library
Patterson Memorial Library
Bonham Public Library
Honey Grove Memorial Library
Sulphur Springs Public Library
Commerce Public Library
Greenville Public Library
Wolfe City Public Library
Paris Public Library
Daingerfield Public Library
Red River County Public Library
Mount Pleasant County Library
Mineola Public Library
Carnegie Library
University of Texas
Paris Junior College
University of Dallas
Texarkana College
East Texas State University
Southern Methodist University
East Texas Baptist College
North Texas State University
Texas A&M University
Colorado State University

INDEX AND APPENDIXES

INDEX AND APPENDIXES (continuation)

APPENDIX A

RESPONSE TO DELETED STATE COMMENTS

APPENDIX A

RESPONSE TO DELETED STATE COMMENTS

Preface. One inadequacy of the final EIS for the Cooper Lake and Channels Project filed June 24, 1977, as detailed by the court in the Memorandum Opinion dated December 8, 1978, was the failure to include State agency comments and failure to address those comments that were made.

State agency review of the draft EIS filed June 10, 1976, was coordinated through the Governor's Budget and Planning Office and comments from ten State agencies were forwarded to that office in July and August of 1976. On August 5, 1976, the Budget and Planning Office provided the Corps of Engineers comments received to date by letter in response to a telephone request by the New Orleans District Office. Formal comments transmitted under the Governor's signature were to follow. On December 14, 1976, a letter from the Governor of Texas was received summarizing the State's position on the Cooper Lake and Channels Project and indicating review by State agencies. No individual State agency comments were attached. This letter and Corps response were published in the final EIS, and the remainder of the State agency comments received earlier were addressed insofar as possible in the text of the final EIS but were not published and responded to specifically.

This appendix responds to this inadequacy by publishing the full text of the State agency comments on the draft EIS, with a specific response by the Corps of Engineers. References in the comments show where in the Final EIS, the comments were responded to as appropriate. This completes the comment and response section (Section IX) of the final EIS. Comments requiring additional response, such as those on the issue of fish and wildlife habitat mitigation, are annotated and responded to in the supplemental EIS. The Governor's Office and the individual State agencies have also had full opportunity to review and comment on the draft supplemental EIS, and their comments and Corps response are included in the main text.

It should be noted that these State agency comments are directed at the Authorized Plan presented in the draft EIS published in June 1976. Based on comments received in coordinating the draft EIS and at the public meeting held in July 1976, the Alternative Reservoir and Levees Plan was recommended in the final EIS. Studies conducted relative to this Supplemental EIS and changes in executive policy regarding wetlands and flood plains which have occurred since 1977 have led to selecting the Alternative Reservoir Only in this final supplemental EIS. The reservoir feature is the same in all three plans.

OFFICE OF THE GOVERNOR
STATE CAPITOL
AUSTIN, TEXAS 78711

WILLIAM P. CLEMENTS, JR
GOVERNOR

February 28, 1980

Colonel Donald J. Palladino
District Engineer
U. S. Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

This is in response to your letter of January 30, 1980 concerning state agency comments on the draft Environmental Impact Statement for Cooper Lake and channels.

I acknowledge your decision to publish the ten agency comments in a draft supplemental EIS and to respond to these comments. In view of all that has transpired in this project over the past four years, this appears to be a reasonable and logical course of action. My office is available for any assistance you may need.

Feel free to contact me if I can be of any service to you in this matter.

Sincerely,

W.P. Clements, Jr.

William P. Clements, Jr.
Governor of Texas

ep

Appendix A

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102

REPLY TO
ATTENTION OF:

30 JAN 1980

SWFED-PR

Honorable William P. Clements, Jr.
Governor of Texas
Austin, Texas 78711

Dear Governor Clements:

On December 14, 1976, the Office of the Governor provided a letter supporting the Cooper Lake and Channels Project in response to a request by the New Orleans District, U.S. Army Corps of Engineers, for review comments on the draft Environmental Impact Statement (EIS) for this project. While this letter stated that the draft EIS was reviewed by your Budget and Planning Office and responsible State agencies, the full text of those review comments was not attached. As you may know, in a December 8, 1978, Memorandum Opinion which enjoined construction of the Cooper Lake and Channels Project, Judge William Wayne Justice ruled that the Corps of Engineers must obtain and publish comments from individual State agencies with appropriate response in the final EIS. Comments from State agencies had been received informally by the Corps of Engineers prior to completing the final EIS on this project. The concerns expressed in these comments were addressed where possible in the text of the final EIS. Judge Justice ruled, however, that the informal consideration of State comments received was not legally sufficient, and the actual letters must be included.

Responsibility for the Cooper Project was transferred to the Fort Worth District from the New Orleans District as a result of a boundary realignment in 1979. The Fort Worth District is now preparing a draft supplemental EIS for the Cooper Lake and Channels Project responding to deficiencies of the final EIS as detailed in Judge Justice's Memorandum Opinion. We intend to publish the full text of comments received from 10 State agencies which were the subject of the deficiency noted above. The State agency commenting and the date of those comments are itemized in Inclosure 1. We will prepare an appropriate response to each comment for the public record and show where in the final EIS those comments were considered, as appropriate. This information will be included in the draft supplemental EIS.

SWFED-PR
Honorable William P. Clements, Jr.

You and the individual State agencies will also have the full opportunity to provide new review comments on the Cooper Lake and Channels Project and alternatives when the draft supplemental EIS is published. The tentative scheduled date for release of this document is September 1980.

Sincerely,

DONALD J. PALLADINO
Colonel, CE
District Engineer

1 Incl
As stated

COOPER LAKE AND CHANNELS
DRAFT ENVIRONMENTAL IMPACT STATEMENT
FILED WITH CEQ 10 JUNE 1976

STATE COMMENTS RECEIVED INFORMALLY

Agency	Date of Comment
Texas Parks and Wildlife Department	August 4, 1976
Texas Water Development Board	July 27, 1976
Texas Department of Agriculture	July 1, 1976
Texas Forest Service	June 30, 1976
Texas Department of Health Resources	July 1, 1976
State Department of Highways and Public Transportation	July 26, 1976
Texas Water Rights Commission	June 23, 1976
Texas Water Quality Board	July 20, 1976
Texas Air Control Board	June 23, 1976
General Land Office	August 11, 1976

OFFICE OF THE GOVERNOR
STATE CAPITOL
AUSTIN, TEXAS 78711

DOLPH BRISCOE
GOVERNOR

August 5, 1976

Mr. David M. Soileau
Environmental Resources Branch
Department of the Army
New Orleans District Corps of Engineers
New Orleans, Louisiana 70160

Dear Mr. Soileau:

Per our telephone conversation this date, I am enclosing a copy of the comments of the Texas reviewing agencies with substantive comment concerning the Lake Cooper project. You will note that the enclosures for the comments for the Texas Parks and Wildlife Department have been omitted.

It is expected that formal comments will be forwarded within the next ten days.

Sincerely,

Albert D. Schutz
Planner

TEXAS WATER RIGHTS COMMISSION
STEPHEN F. AUSTIN STATE OFFICE BUILDING

COMMISSIONERS
JOE D. CARTER, CHAIRMAN
475 2453
DORSEY B. HARDEMAN
475 4326
JOE R. CARROLL
475 2461

R. E. (BOB) SCHNEIDER
EXECUTIVE DIRECTOR
475 2462
MARY ANN HEFNER
SECRETARY
475-4514

June 23, 1976

Mr. Charles D. Travis, Director
Governor's Budget and Planning Office
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Attention: Mr. H. Anthony Breard

Re: U.S. Corps of Engineers, New Orleans District -- Draft Environmental Statement (DES) on Cooper Lake and Channels, Texas, June 1976.

Dear Mr. Travis:

In response to the request in your letter of June 16, 1976, the Commission staff has reviewed the referenced document and presents the following comments and recommendations:

1. We believe that the document fulfills the basic analytical, coordinative, and administrative requirements of Section 102(2)(C) of the National Environmental Policy Act of 1969, insofar as water rights are concerned. Specifically, we note that the referenced environmental study affirms the social, economic, and environmental feasibility of joint operation of the proposed Cooper Lake and the existing Wright Patman Lake in order to achieve enhanced water use benefits. (Reference Section 1.03(a) 1, DES.) Thus, the findings in the referenced environmental study confirm and complement the technical feasibility determinations made by the Commission in connection with the issuance of water rights permits for the Cooper Lake project, and other projects in the Sulphur River Basin. We believe that the referenced document, which reveals that about 45% of the total annual benefits of the project are recreational industry benefits, should dispel any previous doubts as to the bona fide, multiple-purpose nature and objectives of the Cooper Lake project. (Reference page 1, DES.)

1. Noted.

2. It is apparent that the expected benefits of the joint reservoir operation are directly and vitally dependent on the efficient

AN EQUAL OPPORTUNITY EMPLOYER
P. O. BOX 13207 AREA CODE 512 AUSTIN, TEXAS 78711

management of the extensive levee system and related land uses and developments in the reservoir project region. Therefore, the Commission staff recommends that the Corps of Engineers take the opportunity afforded in Section 3 of the referenced DES to emphasize even more the real importance of very careful planning by all agencies concerned relative to future development and growth within the existing and future leveed regions and in other riverine, flood plain areas below Cooper Lake and Wright Patman Lake, which will be afforded the planned 30-year flood frequency protection.

2. Noted

We appreciated the opportunity to review the referenced document. We commend the authors and planners involved in its preparation. The above numbered comments and recommendations are made with constructive intent. If you have any questions, please let us know. Notify Dr. Alfred J. D'Arezzo, Special Analyst for Environment and Interagency Coordination, (Phone: (512) 475-2678.

Very truly yours,

TEXAS WATER RIGHTS COMMISSION

for Alfred J. D'Arezzo

Robert E. Schneider
Executive Director

RES-AJD:11

TEXAS AIR CONTROL BOARD

PHONE 512/451-5711
8520 SHOAL CREEK BOULEVARD
AUSTIN, TEXAS – 78758

CHARLES R. BARDEN, P.E.
EXECUTIVE DIRECTOR

June 23, 1976

Mr. H. Anthony Breard
Natural Resources Section
Budget and Planning Office
Office of the Governor
411 West 13th Street
Austin, Texas 78701

Re: Draft Environmental Statement: Cooper Lake and Channels, Texas

Dear Mr. Breard:

(1) We have reviewed the above cited document. Although there will be some temporary, localized effects during construction due to dust and machinery exhaust, we believe this will not significantly affect the overall ambient air quality. Additionally, there will be motor vehicle exhaust emissions associated with the one and a half million visitors anticipated annually. Any adverse air quality effects from these emissions could be discussed. Any outdoor burning should be done in accordance with the Rules and Regulations of the Texas Air Control Board.

Thank you for the review opportunity. If we can assist further, please contact me.

Sincerely yours,

Bill Stewart, P.E.
Deputy Director
Control and Prevention

cc: Mr. Richard Leard, Regional Supervisor, Tyler

(1) Noted. It is recognized that vehicle emissions will incrementally add air pollutants to the region. In view of the local good air quality, rural nature of the project, and limited nature of vehicle use expected in recreational areas except on peak use days, these adverse effects should be minor. Outdoor burning will be in compliance with State and Federal rules and regulations.

TO: Charles D. Travis, Director
Budget and Planning Office
Office of the Governor
(Attn: State Clearinghouse)

Date: Sent: June 30, 1976

Date: Due: July 23, 1976

Refer: EIS- 6-06-009

FROM: *Texas Forest Service*

SUBJECT: DRAFT ENVIRONMENTAL STATEMENT: COOPER LAKE AND CHANNELS, TEXAS

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item: None	Comment enclosed
1. Additional specific effects which should be assessed.		✓
2. Additional alternatives which should be considered:		
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:		✓
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources.		
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:		
6. We identify issues which require further discussion or resolution:		✓

☐ This agency concurs with the implementation of this project.

☐ This agency does not wish to comment on the subject document because:

Mason C. Cloud

Mason C. Cloud, Head, Forest Environment Dept.
Name & title of Reviewing official

Enclosure(s)

AD-A100 100 ARMY ENGINEER DISTRICT FORT WORTH TEX F/G 13/2

COOPER LAKE AND CHANNELS, TEXAS. SUPPLEMENT.(U)

JUN 77

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3 OF 9

AD A100100

TEXAS FOREST SERVICE

File 5.7

College Station, Texas 77843
June 30, 1976

RECEIVED
JUL 5 1976
Budget/Planning

Mr. Albert D. Schutz
Budget and Planning Office
Office of the Governor
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Dear Al:

This is in response to your circular letter of June 16 concerning the Draft Environmental Statement, Cooper Lake and Channels, Texas dated June 1976.

Our comments on the subject document are spread below.

1. A review of the Texas Champion Tree Registry indicates there are no National or State Champion Trees located within the project area.

2. There are no endangered or threatened floral taxa within the project area as stated on page IV-6, paragraph 4a and Appendix B, of the report. However, the plant inventory list should indicate the method and procedure by which the inventory was compiled. In addition, a small stand of American Chestnut trees Castanea dentata (Marsh.) Borkh, located near the community of Box Elder in Red River County, approximately three miles east of the upper reaches of Shawnee Creek and the Sulphur River, may undergo critical habitat change and a subsequent modification of the ecosystem as a result of the project.

3. It would be helpful for the economic analysis and projection of the benefit/cost ratio if additional economic data were included in the report to reflect the present volume and value of marketable timber in the project area and the volume and value of marketable timber being produced annually, as well as wildlife values, that will be lost (as a result of the conversion process) for the life of the project, which will be well over 100 years in this case. In other words, if flood control benefits are projected based upon conversion of bottomlands to croplands and additional impacts of mitigated wildlife lands,

1. Noted.

2. The "plant inventory list" was the result of a survey conducted by Dr. Evan P. Roberts, Professor of Biology, East Texas State University, and six assistants. Eighteen collecting sites (refer to plate II-5 of the final EIS) were selected in a manner to insure a sufficient number of locations within each of the vegetative areas of the basin. The method of collecting specimens consisted of the team going to each site at the river bank and separating from each other a distance of 25 yards. Each member of the team proceeded 100 yards from the river. All types of higher plants were collected within this 17,500 square yard area at each location. Plants from each location were dried, pressed, identified and remain in the East Texas State University herbarium.

Your comment regarding the chestnut trees was previously addressed in the response to a similar comment from the US Department of Agriculture, Forest Service, on page IX-9 of the final EIS.

3. A discussion of the proposed plan's effect on commercial bottomland hardwood production within the study area was included in a response to a similar comment by the US Department of Agriculture, Forest Service, on page IX-6 of the final EIS. Economic values of wildlife and loss of production from marketable timber on lands acquired were considered in the benefit/cost analysis.

the economic assessment process must obviously include losses that would accrue from the implied conversion.

4. Summary pages II, III and IV refer in part to "pounds of commercial fish harvested" on an annual basis with values ranging from 12¢, 14¢, 15¢ to $1.67 per pound...justification statements need to be included for these different values.

5. It is difficult to comprehend the economic analysis and stated benefit/cost ratio for the project where it requires 30,000 acres for reservoir and upstream ROW, of which 21,000 acres are agricultural or modified agricultural land, to provide 30-year flood protection for only 8,200 acres of agricultural land below the dam (see pages IV-4 and VIII-1)!

Sincerely,

Mason C. Cloud
Head, Forest Environment Dept.

MC/jc
cc: Bob Dodson, Southeastern Area, USFS
Colonel Early J. Rush

4. All of the values in the summary are rounded estimates used to give the reader a general indication of the quantified impacts; more precise estimates are contained throughout sections 4 and 6 and in tables IV-2, IV-3, and IV-4 of the final EIS. Since these figures were rounded, we find no particular problem with the average value of a pound of commercial fish ranging from 12¢ to 15¢. The $1.67 figure that you site, however, is not the average value of a pound of fish. Closer inspection of the data presented will indicate that the $1.67 figure actually represents an average value for a man-day of consumptive recreation and a pound of commercial fish, combined. Reference to table IV-3 will show that, in fact, the average value for commercial fish is actually 15¢.

5. The benefit/cost ratio of the proposed plan represents a comparison between all quantifiable project benefits and costs. A monetized listing of benefits reflected in this benefit-to-cost determination was included in the summary sheet of economic analyses, which appeared at the forefront of the subject text. Additional data on benefit/cost methodology and analysis is now included in the supplemental EIS. The multiple use of the 30,000 acre R.O.W. for the project accrues benefits for water supply, recreation, fish and wildlife, and redevelopment in addition to flood control. Recommending the reservoir does not purport to justify the taking of 21,000 acres of agricultural land for flood protection to 8,200 acres of cleared land downstream for the purpose of flood control only.

TO: Charles D. Travis, Director
Budget and Planning Office
Office of the Governor
(Attn: State Clearinghouse)

Date: Sent:

Date: Due: July 23, 1976

FROM:

Refer: EIS- 6-06-009

SUBJECT: DRAFT ENVIRONMENTAL STATEMENT: COOPER LAKE AND CHANNELS, TEXAS

RECEIVED

JUL 7 1976

BUDG

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (✓) for each item: None	Comment enclosed
1. Additional specific effects which should be assessed:		✓
2. Additional alternatives which should be considered:	✓	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	✓	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources.	✓	
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	✓	
6. We identify issues which require further discussion or resolution:		✓

☐ This agency concurs with the implementation of this project.

☐ This agency does not wish to comment on the subject document because:

Edmund L. [signature]
Name & title of Reviewing official
asst. comm.

Enclosure(s)

Appendix A
14

Texas Department of Agriculture
Office of the Commissioner

Austin, Texas 78711
Phone (512) 475-3324

MEMO

DATE: July 1, 1976

RE: Comments, DEIS: Cooper Lake and Channels, Texas

(1) Category 1: The plan calls for taking about 20,000 acres of land out of agricultural use. This taking of 3% of the area's agricultural land is not justified in the DEIS; indeed, it is not evaluated quantitatively. A more detailed assessment should be made of the impact on agriculture and its long term implications for food and fiber production.

(2) Category 6: The Benefit to Cost Ratio is stated to be 1.8 to 1.0. This determination is not supported by any quantitative analysis or calculations. Such anaylses should be included.

Ed Nichols, Assistant Commissioner

(1) The price paid for lands acquired for project construction, operation, or maintenance represents, as a minimum, the capitalized value of all future earnings expected by the seller from ownership of that property over a certain period of time. In this manner, the loss of food and fiber production associated with the displacement of about 20,000 acres of agricultural lands by the proposed project has been assessed and included in the economic analysis as a project cost. Loss of production and taxes on lands were also included as a specific project cost of each alternative (1974 analysis). This amounted to an annual charge of $266,000 for the reservoir and levees alternative.

Most of the cleared land being utilized by the project is not under intensive agricultural use. Therefore, the impact of total agricultural productivity of the region will not be great under the current structure of input costs and product prices. However, a new opportunity will exist for rather intensive use of the Sulphur River Flood Plain below the reservoir. The total agricultural productivity of the area will be enhanced as a result of projected development.

(2) Support of methodology used in calculating benefit/cost ratios is now included in the supplemental EIS. This information was included in other planning documents prepared by the Corps of Engineers which are matters of public record, but was not presented in detail in the final EIS. The benefit to cost ratio reflects all multiple purpose quantifiable costs and benefits, and inevitably tradeoffs are made between long term resource uses to achieve multiple project objectives.

AGENCY REVIEW TRANSMITTAL SHEET

TO: James M. Rose, Director
Division of Planning Coordination
Office of the Governor
(Attn: State Clearinghouse)

Date: Sent

Date: Due July 23, 1976

Refer: EIS- 6-06-009

FROM: Dr. Fratis Duff - T.D.H.R.

SUBJECT: DRAFT ENVIRONMENTAL STATEMENT: COOPER LAKE AND CHANNELS, TEXAS

We have reviewed the cited document and our comments as to the adequacy of treatment of environmental effects of concern are shown below:

	Check (X) for each item: None	Check (X) for each item: Comment enclosed
1. Additional specific effects which should be assessed:		x
2. Additional alternatives which should be considered:	x	
3. Better or more appropriate measures and standards which should be used to evaluate environmental effects:	x	
4. Additional control measures which should be applied to reduce adverse environmental effects or to avoid or minimize the irreversible or irretrievable commitment of resources:		x
5. Our assessment of how serious the environmental damage from this project might be, using the best alternative and control measures:	x	
6. We identify issues which require further discussion or resolution:		x

[x] This agency concurs with the implementation of this project.

[ ] This agency does not wish to comment on the subject document because:

David L. Houston

David L. Houston, P.E., Chief
Field Activities Branch
Wastewater Technology Division, TDHR
Name & Title of Reviewing Official

Enclosure (s)

Texas Department of Health Resources

Fratis L. Duff, M.D., Dr.P.H.
Director
Raymond T. Moore, M.D.
Deputy Director

1100 West 49th Street
Austin, Texas 78756
(512) 454-3781

July 1, 1976

RECEIVED
JUL 7 1976
Budget/Planning

Mr. Charles D. Travis, Director
Governor's Budget and Planning
Office
Executive Office Building
411 West 13th Street
Austin, Texas 78701

ATTENTION: John Janak, Assistant Chief
Intergovernmental Coordination

SUBJECT: Draft Environmental Statement:
Cooper Lake and Channels, Texas

Dear Mr. Travis:

This is to acknowledge a letter from Mr. H. Anthony Breard of your office requesting that we review the "Draft Environmental Statement: Cooper Lake and Channels, Texas."

(1) We have completed our review and note that the foremost economic benefit expected to be derived from the proposed project relates to recreational activities and use of the reservoir as a source of domestic water supply facilities to serve the expected influx of visitors to the reservoir when completed. It would seem to be imperative that adequate wastewater disposal facilities be provided to protect the quality of waters destined for domestic supply purposes. Also, potable water should be provided for visitors to the area.

(2) The reservoir waters, which are to be quite deep, occasionally would very likely have objectionable tastes and odors from decaying vegetation. In addition, standing timber in the shallow water areas along the periphery of the reservoir would possibly create a suitable habitat for macrophytic aquatic vegetation which could have an adverse effect upon water quality.

(1) We concur, and adequate wastewater disposal facilities will be developed and potable water will be provided visitors to the area. The water supply pool will help meet needs of the cities of Commerce, Cooper, Sulphur Springs, and Irving, and the service area of the North Texas Municipal Water District. The water supply is not for visitors to the lake.

(2) The mean depth of the reservoir for use as a municipal and industrial water supply will be only 16 feet. The mean depth of the reservoir when it is utilized for flood control will be only 19 feet. This represents a relatively shallow reservoir, not one that is "quite deep." Regarding decaying vegetation, 15,853 acres of the 20,425 acres below elevation 442 feet mean sea level (2 feet above the water supply pool) are proposed to be cleared of all timber, structures, fences and major underbrush. The remaining underbrush and grass will remain and will decay over a period of time after the lake is filled. This remaining decaying vegetation could possibly cause some minor taste and odor problems in the reservoir, although it is not anticipated. This is based on the fact that we have not, to our knowledge, had any taste and odor problems in either Wright Patman Lake or Lake O' the Pines, two lakes that have had less clearing than will take place in Cooper. The final EIS was revised in section IV to add a section with recommendations for vector control. The proposed measures for vector control will include reduction of mosquito breeding areas by clearing of the dense underbrush and cover around the perimeter of the reservoir, by filling potholes, and other areas which could trap water, by allowing only a minimum of aquatic vegetation along the reservoir banks, and by removing all floating debris. The clearing of the aquatic vegetation along the bank as a means of vector control should minimize the adverse impact on water quality that the growth of macrophytic aquatic vegetation would have.

Mr. Travis
Page 2
July 1, 1976

(3) The report does not address the possible creation of favorable habitat for mosquito production, especially in those isolated, natural channels which are to be bypassed with an artificial, straightened drainage channel.

(4) It is recommended that the final environmental impact statement include specific information on the following items:

1. Provision of proper wastewater disposal and water supply facilities at appropriate locations in recreational areas.

2. An outline of a proposed program for the collection and disposal of trash and garbage.

3. Details of planned monitoring and control programs for vector organisms in the reservoir area and the natural isolated water areas resulting from channel modification.

We appreciate the opportunity to review and comment on this proposed project.

Sincerely,

Fratis L. Duff, M.D.
Director

(3) Channel construction would deny habitat to temporary water breeders such as Aedes sp. Oxbows created by channel realinement and borrow areas utilized for levee construction would revert to habitat for permanent water breeders such as Anapheles sp. and Culex sp. No further channel work is now recommended.

(4) Details of the nature (Items 1 and 2) are unavailable at this time for inclusion into the EIS. They will be included in the Master Plan for Cooper Reservoir at a later date. However, it should be pointed out that any wastewater or water supply facility installed at Cooper Reservoir will comply with local, State, and Federal regulations and criteria. Item 3 was addressed in the final EIS on pages IV-6, IV-26, and IV-34.

TEXAS WATER QUALITY BOARD

1700 NORTH CONGRESS AVE
P.O. BOX 13246 CAPITOL STATION 78711
AUSTIN, TEXAS

July 20, 1976

Re: Draft Environmental Impact Statement
for Cooper Lake and Channels Project
Corps of Engineers

Mr. Charles D. Travis, Director
Governor's Budget and Planning Office
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Dear Mr. Travis:

(1) The staff of the Texas Water Quality Board has reviewed the draft environmental impact statement for the proposed Cooper Lake and Channels as prepared by the Corps of Engineers and have determined that no lasting harmful effects on water quality will result from the project. The erosion control provision proposed for the prevention of pollution is also shown to be an enhancement to the water supply features of the project.

(1) Noted.

We appreciate the opportunity to review this project. If we can be of further assistance to you, please let me know.

Very truly yours,

Emory G. Long

Emory G. Long, Director
Administrative Operations

cc: Col. Early J. Rush III, District Engineer
New Orleans, LA

STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION
AUSTIN, TEXAS 78701

COMMISSION
REAGAN HOUSTON, CHAIRMAN
DEWITT C. GREER
CHARLES E. SIMONS

ENGINEER DIRECTOR
B. L. DEBERRY

July 26, 1976

IN REPLY REFER TO
FILE NO.
D8-E 454

Draft Environmental Statement
U.S. Army Engineer District
Delta, Hopkins, Titus, Morris and Bowie Counties

Cooper Lake and Channels

Mr. H. Anthony Breard, Coordinator
Natural Resources Section
Budget and Planning Office
Office of the Governor
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Dear Sir:

Reference is made to your memorandum dated June 16, 1976 transmitting the subject draft environmental statement for review and comment.

(1) The Department has reviewed the statement and finds that the total project encompassed by this Draft Environmental Impact Statement has merit; however, adverse impacts will most likely materialize from the channelization portion of the project downstream from Cooper Reservoir that the Environmental Impact Statement does not address. On page iii under (2) Levees and Channels, it is stated that "a high sediment load -- should be only a temporary occurrence until the channel has reached its anticipated design carrying capacity". This involves the same process used in other channel rectification projects on the Sulphur River. A pilot channel is first constructed and from the action of flood waters the pilot channel will expand to a desired cross section. Although this approach may represent, to some degree, a valid process for channel development, it is not clear from the report as to what the anticipated design capacity might be, nor how further expansion of the channel will be controlled once the desired limits are attained.

(2) This lack of control regarding the channel expansion on previous Sulphur River Basin Channel projects has cost this Department more than ½ million dollars for maintenance and remedial construction, and over $600,000 is to be spent

(1) The pilot channel was anticipated to enlarge a minimum of 400 percent in a 10-year period. The channel expansion was expected to continue after this period for an additional 30 to 40 years before it reaches stabilization. Stabilization would occur with some sections of the channel reaching about 2,000 percent enlargement; however, the average enlargement of the system would be expected to level off at 1,600 percent. It was not intended to control expansion of the channel after the initial 10-year period or limit the channel expansion to 400 percent enlargement, but to let the channelization process continue until stabilization is reached through the natural process. With selection of the reservoir and levees plan in the final EIS, new channelization was reduced to about 6.7 miles in two locations in conjunction with levee work. The plan now recommended in the supplemental EIS recommends no further channel work.

(2) Noted.

Comment	Response
in the near future to repair badly damaged highway bridges, replace damaged highway bridges and/or provide for erosion control. There is no estimate at this time of the highway funds already expended to build highway bridges longer than would be necessary to satisfy the hydraulic requirements of a crossing because reasonable estimates of ultimate channel expansion could not be made at many highway/stream crossings in the Sulphur River Basin.	
(3) Further, the sediment originating from the expanding channels is transported to and deposited in the vicinity of S.H. 37. This deposition has been more than a temporary occurrence and caused numerous maintenance problems at S.H. 37 before the present crossing was constructed because the waterway openings provided by the previous highway bridge were almost closed. The reduced waterway opening caused frequent overtopping of the S.H. 37 structures and roadway and in addition contributed to very large accumulations of drift and debris on the upstream side of S.H. 37. Mostly because of these problems, the previous S.H. 37 crossing of the Sulphur River was replaced.	(3) Noted.
(4) The plans for channel rectification downstream of Cooper Reservoir are of the most concern. Based upon the similarity of portions of this project to previous channel projects, there is every reason to believe the same type problems could also occur. Plate I-1 of the Draft Environmental Impact Statement indicates new channel from Station 1519+50 to Station 3122+00 with the exception of 160 stations downstream of Talco. This will consist of a pilot channel on a fairly good alignment (which means a steeper slope) from near S.H. 37 to near U.S. 259. This could result in specific problems at S.H. 37, U.S. 271 and U.S. 259. The Department endorses the total concept of the plan of flood prevention, etc.. However, positive provisions should be established for the monitoring and control of the morphological events which are set in motion when a channel is left to "dig" itself.	(4) Refer to the response to your first comment. All of the remaining channel work has been deleted from the recommended plan in the supplemental EIS.
(5) It is believed that the economic effects of erosion and siltation on highway facilities have received very little, if any, consideration. The U.S. Army Corps of Engineers should be prepared to recognize these effects on the highway system and be prepared to rectify any damages that may be caused by their actions.	(5) The Federal Government recognizes the effects of its projects on the highway system. The plan now recommended includes no further channel work in downstream areas which would affect highway facilities.

Thank you for the opportunity to review the statement.

Sincerely yours

B. L. DeBerry
Engineer-Director

By: R L Lewis
R. L. Lewis, Chief Engineer
of Highway Design

cc: Federal Highway Administration

TEXAS WATER DEVELOPMENT BOARD

JAMES M. ROSE
Executive Director

P.O. BOX 13087
CAPITOL STATION
AUSTIN, TEXAS 78711

AREA CODE 512
475-3187
1700 NORTH CONGRESS AVENUE

RECEIVED
AUG 3 1976
Budget/Planning

July 27, 1976

IN REPLY REFER TO
TWDBP

Mr. Charles D. Travis, Director
Governor's Budget and Planning Division
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Attention: Mr. H. Anthony Breard

Re: Draft Environmental Impact Statement: Cooper Lake and Channels, Texas, prepared by U.S. Army Engineer District, New Orleans, Louisiana.

Dear Mr. Travis:

(1) The Water Development staff has reviewed the above-cited Draft Environmental Impact Statement for Cooper Lake and Channels, Texas and offers the following comments and suggestions for your consideration. The project is included in the Texas Water Plan and is a high priority project. The Water Development Board strongly supports the project and urges that it be developed as soon as possible.

(1) Noted.

(2) Cooper Lake and Channels, Texas consists of a multiple-purpose lake for flood control, water supply, and recreation on the South Sulphur River, southeast of Cooper, Texas, and channel improvements, levees, and appurtenant drainage works along Sulphur River and its tributaries upstream from the flood control pool of Wright Patman Lake. The Texas Water Development Board feels this is an urgently needed project, since the population of the impacted region is projected to increase more than 50 percent in the next 50 years.

(2) Noted.

(3) Environmental effects of the project have been adequately presented in the draft statement, and indicate that the overall benefits which will occur as a result of implementing this proposed project far outweigh the inescapable adverse effects if the project is not implemented. The Corps of Engineers has cooperated with the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department in order to satisfy requirements of the Fish and Wildlife Coordination Act by adopting their recommendations, where feasible, in light of the many aspects of the project.

(3) Noted.

(4) The draft environmental impact statement contains estimates of dollar benefits of reservoir recreation activity to range from $1.48 to $2.08 per man-day. Water Development Board estimates of reservoir recreation benefits in Texas indicate that recreation benefits vary among reservoir recreation areas but almost uniformly exceed the daily values used in this draft report. Thus, we feel that recreation benefits have been underestimated for the Cooper project.

(5) Agricultural data are presented for only two years, 1949 and 1969. Therefore it is difficult to discern long-term trends in agricultural productivity and land use in the impacted region.

(6) Cooper project water supply is needed to support the growing economy of the region. Water Development Board projections indicate that income earnings in the area will grow 619 percent in the next 50 years. In 1970, 30.6% of the total regional earnings originated in the manufacturing sector (of this, 20.4% originated specifically in the fabricated metals sub-sector), another 22.1% of the total originated in civilian government, and 15.8% in wholesale and retail trade. The projections indicate that in 2020 manufacturing earnings will account for 29.8% of the total, civilian government for 20.7%, and wholesale and retail trade for 16.4% of the regional total. The remaining income is from agriculture, service, utilities, and construction industries, but without an adequate water supply the projected level of economic activity cannot be achieved. The Cooper project would provide a part of the needed water.

Sincerely,

James M. Rose

JMR:dc

(4) Since the proposed project was authorized prior to 25 October 1973, unit day values were assigned within the range established by Senate Document No. 97. Although these values may seem somewhat conservative, we did elect to use the highest possible unit day value, within the range allowed in Senate Document No. 97, for the various types of recreation. A reanalysis of recreation benefits using values from Principles and Standards is now included in the supplemental EIS for information.

(5) Agricultural data from the US Department of Commerce for the year 1959 were included in table II-22 (page II-87) in order to demonstrate the validity of those historic trends expressed within the text of the final EIS. Data for the years 1954 and 1964 were also evaluated, which reaffirmed the soundness of those stated conclusions but were not included within the referenced table for the sake of orderliness. In addition, the US Department of Agriculture has published data on counties within the study area for the years 1970 through 1974, which gives indication of the continued importance of livestock production as the predominant source of total agricultural activity within the Sulphur River Basin.

(6) Noted.

TEXAS

PARKS AND WILDLIFE DEPARTMENT

CLAYTON T. GARRISON
EXECUTIVE DIRECTOR

JOHN H. REAGAN BUILDING
AUSTIN, TEXAS 78701

August 4, 1976

Mr. H. Anthony Breard, Coordinator
Natural Resources Section
Governor's Budget and Planning Office
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Dear Mr. Breard:

The Texas Parks and Wildlife Department has reviewed the Draft Environmental Statement: Cooper Lake, Texas, dated June, 1976. We offer the following comments.

WILDLIFE RESOURCES

(1) Reference is made to the remarks in paragraph 2.05, Section h, (2), Page II-79 of the draft statement. Data contained in the referenced Texas Parks and Wildlife Department Job 2 report is an average figure for all deer range (primarily uplands) in nine northeast Texas counties and, therefore, is not directly applicable to data presented in Table II-30, which was compiled specifically for the Sulphur River Basin below the proposed Cooper Reservoir damsite.

(2) Table IV-2, Page IV-10 suggests that the proposed reservoir will provide some 4,315 man-days of waterfowl hunting benefits annually. In general, the Texas Parks and Wildlife Department has found waterfowl hunting to be poor on deep, open-water reservoirs of northeast Texas. Successful waterfowl hunting is usually restricted to shallow-water areas where timber remains to provide some cover and protection for waterfowl. For this reason, it is suggested that data concerning plans for leaving standing timber in the reservoir be included in the draft environmental statement. This would provide the basis for a better assessment of projected waterfowl hunting benefits.

CORPS RESPONSE

(1) The referenced paragraph 2.05 h. (2) was deleted from page II-54 of the final EIS since these data are not applicable to the Sulphur River Basin.

(2) We agree with the general observation that large open-water reservoirs, virtually devoid of timber, make poor waterfowl habitat. Cooper reservoir, however, will flood many of the small wooded tributaries. These areas should be prime waterfowl resting habitat and, accordingly, we contend that the estimated waterfowl hunting benefits are justified. Data on clearing were contained in paragraph 4.02 c(4)(b) 1 on page IV-35 of the final EIS, and in a reservoir clearing Design Memorandum reviewed by Federal and State agencies, and approved 3 November 1969.

(3) In reviewing the draft statement, we were unable to find data relative to losses of furbearer habitat and furbearers which will result from construction and innundation. In our opinion, considering current high values of fur pelts, an estimate of these losses should be presented.

(4) Similarly, the statement does not reference projected lost productivity of native woodducks which will result from the clearing of bottomland. This Department recommends that projected losses should be based on a breeding pair of woodducks per 50 acres, production of one woodduck per 10 acres, and one (1) man-day of hunting per 25 acres.

(5) In view of the present market, the Parks and Wildlife Department considers the values for man-days of hunting used in the draft statement too low and finds that they do not provide for projected increased values of hunting man-days which should be anticipated in future years. We suggest that man-days of hunting is not an equitable measure. We recommend that Principles and Standards procedures, as used to develop data for the forthcoming report from the U. S. Fish and Wildlife Service, be used to more accurately reflect the true ecological impact to result from implementation of the authorized plan.

(6) In the appendix to the draft statement, the list of mammals indicates the gray squirrel is uncommon in the basin. This is true for the westward reaches of the area. Our records, however, indicate that the gray squirrel is common to the east of Highway 37 and should be so listed.

(7) Nowhere in the draft statement do we find any indication of the degree of impact which the operation of Cooper Reservoir would have on the conservation storage of Wright Patman Reservoir. During a meeting held by the U. S. Army Corps of Engineers in Texarkana in 1972, Corps of Engineers' representatives stated that the level of Wright Patman Reservoir would be raised several feet upon completion of Cooper Reservoir. This meeting concerned a possible management license for lands around Wright Patman Reservoir. Since this increase in water level could impact the current situation at Wright Patman, we recommend that this be addressed in the environmental statement for Cooper Reservoir.

FISHERIES RESOURCES

(8) In Table I-1 on Page I-3, it is stated that Cooper Dam will be of a rolled/fill earth type. Since the Parks and Wildlife Department has found that rock riprap provides a much more desirable habitat for fishes, we recommend that rock riprap be used rather than soil cement which has been used on some dam projects.

(3) A discussion of potential losses in commercial furbearer resources was included in paragraph 4.02 b(1)(c) 4 on page IV-21 of the final EIS. In addition a summary column in table IV-4 itemized commercial trapping losses for each alternative.

(4) In Section 4.02 b(1)(c) d. on page IV-20 of the final EIS we indicated that waterfowl hunting in the basin primarily involves the harvesting of wood ducks. Accordingly, the estimate of losses in waterfowl hunting are almost synonomous with the projected losses in wood duck hunting that you requested.

Our estimate of losses in man-days of waterfowl hunting (i.e., wood duck hunting) were computed for bottomland hardwoods lost directly from construction features and indirectly from induced clearing; accordingly, all estimates of waterfowl hunting losses for each alternative presented in table IV-4 on page IV-22 reflected both direct and indirect project induced losses.

We have elected to use your estimate of one (1) man-day of hunting per 25 acres in our computation of project induced losses in waterfowl hunting. Accordingly, we have revised our estimate of waterfowl losses throughout the EIS; a summary of these revisions and their effect on the total estimated wildlife and fishery project induced losses was contained in table IV-4 on page IV-22 of the final EIS.

(5) Values used represent potential recreational benefits as indicated in table IV-4, and accordingly, they do represent the anticipated future values under existing, unmanaged conditions.

We agree that man-days of hunting, alone, are not an equitable measure of natural resource losses. We, in fact, included estimated losses in several other categories: sport fishing, commercial fishing, nonconsumptive recreation, and, as you recommended in a previous comment, commercial fur trapping. An ecologically based evaluation was conducted after preparation of the final EIS, with results now presented in the supplemental EIS.

Since the project was authorized prior to 25 October 1973, unit day values were assigned within the range established in Senate Document No 97 (87th Congress, 2nd Session; approved by the President on 15 May 1962). Although these values may seem somewhat conservative, we did elect to use the highest allowable unit day value, within the range allowed in Senate Document No. 97, for the various types of recreation. In addition, we were consistent in our assignment of recreation values when estimating both benefits and costs to recreation resources; thus, we feel that any comparisons of benefits and losses among alternatives are valid. An analysis using higher values allowed by Principles and Standards is presented in the supplemental EIS for information.

(6) The appropriate change has been made in appendix C which is on file at the Fort Worth District office.

(7) Refer to revised paragraph 1.06 of the final EIS on page I-15. The pool raise at Wright Patman would be allowed after construction of Cooper Lake, but it is not required. A separate EIS on this action will be prepared.

(8) As currently designed, the lake side face of the dam will be designed to be flat enough to not require rip-rap protection. Cost savings will be several million dollars over using rip-rap due primarily to the unavailability locally of this material. Soil cement will be used on upper embankment slopes.

(9) Remarks on Page IV-2 are made concerning a minimum release of five (5) cubic feet per second (cfs) to maintain fish and wildlife needs below Cooper Dam. We are concerned that this may not be sufficient flow to prevent oxygen depletion and the stranding of fishes below the dam during periods of minimal flow. For this reason, it is recommended that a minimum flow of 10-15 cfs be maintained during the summer period. This would sustain a tailrace fishery. We further recommend that higher flow rates, when being reduced during the spring, be reduced gradually. This, too, would serve to prevent the stranding of fishes in the dam's tailrace.

(10) Large and diverse fish populations are generally existent in tailwater areas of reservoirs. These areas are often the site of intense fishing pressure, with a catch rate at times much higher than in the reservoir itself. This is generally true in unchannelized stream areas below reservoirs. It is not true in channelized streams. For this reason, the Parks and Wildlife Department recommends that the environmental statement point out that fisheries populations in the proposed channelized stream below Cooper Dam can be expected to be adversely affected. The statement should also reflect that the tailrace fishery can be expected to be less productive than is generally the case.

(11) The draft statement does not address tailwater access, facilities or engineering design to prevent minimum flow stranding and loss of fish. This Department recommends that public access, with ample parking space and restrooms, be provided. We suggest that walkways parallel to the outlet flow and constructed at varied levels could increase fishing recreation at this tailrace. We feel that a design similar to the Corps of Engineers' Lake O' the Pines project would be desirable.

(12) On Page IV-3 it is stated that thermal stratification will cause seasonal variations in water quality, nutrients and other factors which often benefit the fish food chain. As written, it appears that the release of nutrients might compensate for periodic stratification when the lake's hypolimnion is not suitable for fish habitat. We suggest the statement should be clarified to indicate that such released nutrients would not be available to the fish food chain except during the fall mixing period or fall turnover.

(13) The statement on Page I-2 concerning discharges to be made through four, six by six-foot gated conduits does not indicate the levels from which water would be released. It is the recommendation of this Department that a three level release mechanism be considered. This would be to provide for surface, subsurface, and near-bottom releases. In this way the quality of water entering the tailrace and downstream areas could be controlled to provide for acceptable fisheries habitat.

(14) On Pages IV-5 and IV-6, reference is made to the fluctuating of water levels in the lake. This Department recommends that operating plans for Cooper

(9) The sustained low flow releases of 5 c.f.s. will prevent existing seasonal zero flow conditions which result in dry streambeds. Further, the lake will entrap a large proportion of suspended solids that now transgress downstream, and thereby reduce the turbidity of released waters. Cooper Lake will be operated in conjunction with Wright Patman Lake in an effort to insure proportionate utilization of flood control storage in both projects insofar as possible while maintaining water supply needs of the basin. Normal releases from Cooper Lake will vary from a minimum of 5 c.f.s. to a maximum of 3,000 c.f.s. These releases will be gradually stepped from one extreme to the other to prevent rapid rates of rise and fall in tailwater elevations and to prevent adverse effects such as stranding on fish populations in the tailrace. Holding and releasing 5 percent of the flood pool at a 30 - 50 c.f.s. rate is also now recommended.

(10) Generally, the adverse effects of the limited channelization has been discussed in Section IV. The reservoir only plan recommended in the supplemental EIS requires no new downstream channelization.

(11) Public access to the dam's tailrace and outflow features will be incorporated into detailed designs for the dam. The requirement for appurtenant recreation and comfort facilities associated with the project is recognized and will be addressed in a detailed recreation master plan to be prepared upon lifting of the injunction.

(12) Complete mixing after a lengthy period of stratification is normal in the fall. This "turnover" would be the most significant in redistribution of nutrients previously isolated in the non-photosynthetic hypolimnion. However, during spring and early summer, lakes stratify and mix at short intervals, maintaining adequate distribution of nutrients during spawning and early growing season.

(13) Multilevel outlets are provided in the project design. Among these outlets are four 6-foot by 6-foot sluices with inverts at elevation 398 feet m.s.l. These sluices will be used in making normal flood releases. There are also two 2-foot by 3-foot openings in one of the service spillway piers with invert elevations of 422 and 436 feet m.s.l. These outlets will be used in making low flow releases. Additionally, unusually large floods that require the use of the service and emergency spillways will flow over weirs set at elevations 426.2 feet m.s.l. and 450 m.s.l., respectively. These multilevel release capabilities will allow development of operational schemes to control downstream water quality.

Reservoir include provision for stable water levels, insofar as possible, during the period March through May of each year. This would improve the success of game fish reproduction and assist in production of successive year classes of fishes.

(15) In order to provide for maximum fisherman and recreation access in the reservoir itself, the Parks and Wildlife Department recommends that boat passage lanes be cleared through timbered areas. We suggest that lanes extending from the main channel should be form 20 to 50 feet wide by 1,000 feet long. Lanes from tributary channels should be 25 to 50 feet wide by 500 feet long. The Department also suggests that timber removed from the reservoir might be used to establish fish "reefs" in open areas of the reservoir. These should be placed along submerged contours at 15 to 30 feet below the water surface. Any such "reefs" should be marked by buoys so that they can be located by fishermen.

(16) Under Alternatives to the Proposed Action, (9), <u>Channel</u> <u>and</u> <u>Levees</u>, beginning on Page VI-31, some 35 miles of realigned channel would be constructed below Cooper Dam. In the opinion of the Parks and Wildlife Department, the long-term impact of this alternative would be: (1) loss of aquatic vegetation along the rivers natural banks due to increased water temperature; (2) increased current velocities; (3) altered hydrologic regimes; (4) increased turbidity; and (5) drastic reduction in aquatic habitat diversity. This would result in a significant reduction in the standing crops of fishes and benthic organisms in the channelized reach. In turn, this would probably adversely affect the remainder of the stream, reduce the quality of the tailrace fishery below Cooper Dam due to reductions in the streams spawning and nursery habitat, and hinder replenishment of fish stocks in Wright Patman Reservoir. For these reasons, the Parks and Wildlife Department recommends against implementation of this or similar alternatives.

(17) The draft statement, on Page IV-16, states that some recreational benefits would result from the creation of oxbow lakes. The statement also states that benefits to be derived from providing public access to these lakes would not justify the cost. This Department suggests that, in light of the present day cost of recreation, public access to these lakes would significantly increase the amount of recreational benefits from them.

(18) In addition to the 3,300 acres of land and facilities to be included in seven recreation areas, it is recommended by this Department that lighted fishing piers be constructed at each of the areas. Additionally, artificial reefs using timber, old tires or rock rubble might be installed at the time of pier construction to enhance fishing.

(14) An established rule curve will prescribe the operational plan for Cooper Lake. That rule curve requires that flood control capacities be preserved by making releases from the lake when water levels exceed elevation 440.0 feet m.s.l. The space between elevations 415.5 and 440.0 is reserved for water supply. This space has been contracted for purchase by local entities. The fluctuation of water levels between these elevations will be primarily influenced by the rates of withdrawal by such entities and by the rate of inflow to the lake. To a lesser extent, these levels will be affected by evaporation, transpiration and infiltration. The water level within the range indicated will be affected through reservoir operational procedures, i.e., by controlling outflow structures, maintaining 5 c.f.s. low flow release, and such excesses over that amount as may be necessary for vector control.

(15) In connection with clearing operations in the reservoir area, boat passage lanes will be provided to enhance recreational access and marine safety. The clearing will also provide fish seining areas to assist fishery resource management. These boat lanes and seining areas will be appropriately designated by navigation aids and marker buoys. A detailed master plan for recreational development will be prepared after the injunction is lifted. This report will adequately address the physical dimensions and design requirements of these features as well as the feasibility of constructing fishing reefs with cleared timber.

(16) Noted.

(17) The economic feasibility of providing public access to the oxbows is not justified. With selection of the reservoir only plan, no oxbows are created and there are no oxbow recreation benefits.

(18) During preparation of the master plan, consideration will be given to your proposal for construction of artificial reefs and lighted fishing piers.

RECREATION

(19) The authorized project, in the opinion of the Parks and Wildlife Department, would not affect any waterway sections having any particularly significant scenic or recreational potentials. The South Sulphur River, because of extreme fluctuations in water levels, does not maintain a desirable flow for canoeing, kayaking or rafting, and channelization which has been done on both the South Fork and the Main Stream has reduced the desirability of the natural, scenic, and recreational qualities of these water courses to the point where little or no waterway recreation participation presently occurs.

(19) Noted.

(20) In the description of the authorized project, it is mentioned that an amount of trails would be provided based upon the number of annual visitors. Also mentioned is a proposal by the Ark-Tex Council of Governments for a hiking and horseback riding trail system in conjunction with the Cooper Lake and Channels project. This Department's feasibility report on a statewide system of trails in Texas, entitled Texas Trailways (Attachment 1), reiterates the Ark-Tex Council of Governments' proposal for a trails system which could connect Cooper Reservoir and its recreational facilities with facilities at Wright Patman Lake. Should an alternative be implemented which includes the levee construction, the levees should be reserved as rights-of-way for development of public recreation trails.

(20) Acquisition of rights-of-way for levee construction does not include a recreation feature. Reservation of levees as rights-of-way for recreation trails would require further authorization from Congress.

The completed levee system has been turned over to local interests for maintenance, with the Federal Government retaining jurisdiction to insure that the system is being properly maintained and not being used for anything which might undermine the integrity of the levees. No additional levees are proposed for construction in the plan now recommended in the supplemental EIS, with the exception of the 0.9 mile 4RSS spur which is necessary for proper operation of the reservoir outlet works.

(21) In the section entitled Nonstructural Alternatives, no mention is made of the beneficial impacts which flood plain regulation and acquisition could have upon restoring and maintaining natural, scenic, and recreational qualities on the Sulphur River which would be desirable for inclusion in a statewide system of waterways.

(21) Section 6.03 a(2)(a) on page VI-34 of the final EIS was modified to include those beneficial impacts. A comprehensive nonstructural plan was developed for presentation in the supplemental EIS.

(22) Additionally, the Nonstructural Alternatives section does not address beneficial impacts which flood plain acquisition and regulation could have by providing opportunities for dispersed-type recreational activites (i.e., hiking, backpacking, bicycling, horseback riding, nature study, and primitive camping). The Texas Trailways report points out that opportunities for such dispersed activities in natural settings close to home are rare and unusual occurrences, and that flood plains have excellent potential for trail development.

(22) These beneficial impacts were addressed in section 6.03 b(2)(a) on page VI-35 and tables VI-3 and VI-4.

(23) The Department appreciates reference to the incorporation of draft Texas Outdoor Recreation Plan (TORP) data in Corps of Engineers' project evaluations. However, please note that TORP (Preliminary Draft) data cited on Pages II-87 through II-90 of the subject document will have undergone minor revision in the final version of the TORP (Attachment 2), an updated Table II-35, Rural Recreation Resource Requirements for Analytical Planning Regions 12 and 13. Therefore, the combining of data for Regions 12 and 13 could result in the possibility of misinterpretations. We would recommend that the final

(23) We displayed the data for Regions 12 and 13 separately in tables II-16 through II-21, pages II-61 through II-66 of the final EIS.

environmental statement display the data for Regions 12 and 13 separately. Interpretation of the data could then be presented with notes indicating estimated requirements in both regions.

(24) The Department notes the draft environmental statement data (Table II-35, Recreation Resource Requirements, Pages II-87 through II-90) as it relates to boating, boat fishing, and skiing flat water resource requirements. As indicated, rural lakes and reservoirs currently existing in Regions 12 and 13 are projected to adequately satisfy requirements for these activities in rural areas through the year 2000.

(25) The Outdoor Recreation in the Rural Areas of Texas (Part I: An Overview) volume of the TORP indicates two rural natural resources in the Cooper Lake project area (Source: Executive Committee of the *Texas Natural Areas* Survey) as follows:

a. Horton Bottom: This five square mile area is located on the north branch of the South Sulphur River and is reported as a zone one mile wide from Highway 1531 to the confluence of Merritt Creek. Reportedly found within this area are numerous archaeological sites and an oak-hickory forest.

The Nutmeg Hickory (Carya myristicaeformis) is known to occur in the lower reaches of the project area. It is a rare hickory in North America but is frequently encountered in the lower Sulphur River Basin. It should be included in the list of plants in the appendix.

b. Sulphur River: The Sulphur River Basin extends through Bowie, Delta, Red River, and Titus Counties. A half-mile to one-mile riverfront zone is reported to contain southern flood plain forest with great quantities of wildlife and numerous lakes and sloughs.

Information on these areas, along with other information, was transmitted on request to the New Orleans Corps of Engineers office on June 19, 1974 (Attachment 3). From our review of maps in the statement, it appears that the upper portions of the Horton Bottom area are included in lands to be acquired for the reservoir.

Although we have not had the opportunity for field investigation, we would recommend the draft statement be altered to note the existence of these areas and that design of project features up and downstream from the reservoir pool be done so as to minimize destructive alteration of the areas.

(24) The rural lakes and reservoirs existing in Regions 12 and 13 have the potential for satisfying the recreation demand. However, this potential is not being realized because of a lack of *adequate access facilities*. Adequate access facilities are proposed at Cooper Lake.

In addition TORP states:

"Proximity to water for many land based activities is important to recreationists. In the development of resource requirements for surface acres, the *availability and suitability of adjacent reservoir lands and* shorelines, use intensity trends, and park occupancy rates on existing reservoirs were not considered in detail. In depth, consideration of these factors may indicate higher surface acreage requirements in order to provide adequate lands adjacent to reservoirs to support the water and land related facility requirements presented in this section."

(25) *a.* Horton Bottom: This area is included in the right-of-way acquired for Cooper Lake. With the exception of a few hundred yards on either side of the South Sulphur River, all of Horton Bottom has been cleared and is under cultivation and/or in pasture land. The oak-hickory forest within a few yards on either side of the river will be lost if permanently inundated. However, the forested area adjacent to the inundated segments of the river will not be disturbed by the project. According to Dr. S. Alan Skinner, Director of the Archeology Research Program at Southern Methodist University, Dallas, Texas, one substantive archeological site is located in this area; but, in general, the area is devoid of sites (telephone communication in September 1976). The nutmeg hickory has been included in appendix B.

b. Sulphur River: We have attested to the natural setting of the Sulphur River Basin throughout Section 2 of the final EIS. A portion of the river referred to here would be channelized with the reservoir and levees alternative, the effects of which were covered in Section 4 of the final EIS. No further downstream channelization is now recommended.

MITIGATION

(26) Current investigations coupled with the complete overview of the Cooper Lake Project presented in the draft statement, reveal that considerably more ecological damage will occur from the project than was preceived ten years ago when measures were suggested to mitigate the losses of fish, wildlife and their habitats. Consequently, this Department suggests that the alternative authorized does not adequately provide for the loss which construction of the project would cause to existing ecosystems.

(27) Bottomland and estuaries are among the most productive areas for fisheries and wildlife. Rapid changes in land use in Texas resulting from reservoir development have caused extensive losses of bottomlands and reductions of freshwater inflow to estuaries.

(28) As called for in the National Environmental Policy Act of 1969 (P.L. 91-190) and the Fish and Wildlife Coordination Act of 1958 (P.L. 85-624), adequate measures to mitigate losses of those natural systems should be blended with economic measures.

(29) The Texas Parks and Wildlife Department is interested in having natural areas set aside and in managing those lands to mitigate losses of wild lands, resulting from development. This activity is being pursued as part of this agency's responsibility to help perpetuate fish and wildlife resources in quantities adequate to satisfy present and future human needs for those resources.

(30) The array of alternatives for the project, presented in the draft statement, indicate opportunities to accomplish a more economically - ecologically balanced project than the authorized plan. Therefore, in light of information in the statement and provisions of P.L. 91-190 and P.L. 85-624, this Department suggests that the project be implemented so as to accomplish a better balance in benefits for the greatest number of people in Texas.

(31) Acquisition of the flood plain and management of the plain to benefit natural ecosystems, or regulation of the uses of the flood plain with emphasis on management to benefit the ecosystems would be more desirable ecological alternatives. However, those alternatives may not adequately accomplish the economic objectives. Alternatives which would more satisfactorily accomplish both economic and ecological needs are suggested to be those including reservoir construction with either:

a. fee purchase of the flood plain plus the setting aside of wildlife management lands within the plain and adequate restrictions to satisfy ecological needs;

b. restrictive easement acquisition of the flood plain plus wildlif management lands within the plain and adequate restrictions to satis, ecological needs; or

(26) Reconsideration of ecological aspects of the project and alternatives are now presented in the supplemental EIS. Mitigative measures based in part on habitat evaluation procedures (HEP) are also presented in the supplement.

(27) Noted.

(28) As per the court's Memorandum Opinion of 8 December 1978, a mitigation plan is presented in the supplemental EIS.

(29) Noted.

(30) The array of alternatives considered in the draft and final EIS as well as additional modifications to structural plans, and new nonstructural and water supply only alternatives are reconsidered in the supplemental EIS in order to recommend the best overall plan in the public interest.

(31) A comprehensive nonstructural flood management plan was formulated in the supplemental EIS. Combinations of structural features with nonstructural measures as we l as mitigation for unavoidable adverse ecological impacts are also considered in the supplemental EIS. Fee purchase of flood plain, restrictive easements, setting aside of lands within the levees, and purchase of wildlife management areas are reconsidered in recommending the best overall plan.

c. levee construction with levees including the flood plain left intact, plus wildlife management lands set aside within the plain.

(32) The Parks and Wildlife Department suggests that bottomland equal in quantity (except as may be influenced by quality or provisions to improve the quality) to that amount which would be lost from the alternative implemented should be set aside for wildlife management and public use.

Mutually acceptable measures for mitigating losses of existing ecosystems, and their related fish and wildlife resources can be accomplished through cooperation between the appropriate federal and State agencies. We propose a meeting of representatives of the U. S. Army Corps of Engineers, U. S. Fish and Wildlife Service, and the Texas Parks and Wildlife Department to discuss the ecological ramifications of the proposed project and to establish mutually acceptable mitigative measures. Representatives from this agency will be available for such a meeting upon short notice.

(33) Finally, it has come to the attention of the Texas Parks and Wildlife Department that Cooper Reservoir may be used as a staging reservoir for transmission of water either into or out of the river basin. Should this information have any basis in fact, such use of the reservoir could have extreme ecological implications and we would recommend that this matter would need to be addressed in detail in the Environmental Impact Statement for the reservoir.

Sincerely,

CLAYTON T. GARRISON
Executive Director

CTG:KCJ:bp

Attachments

(32) Pursuant to the Memorandum Opinion, a mitigation plan, coordinated with the U. S. Fish and Wildlife Service and the Texas Parks and Wildlife Department, is recommended by the Corps of Engineers in the supplemental EIS.

(33) The Texas Water Development Board (TWDB) has formulated the Texas Water Plan intended to fulfill the future water needs for the State of Texas. That plan was approved by the Texas State Legislature as a flexible guide to the water resource needs of the State.

In cognizance of that plan, in 1968, the TWDB entered into contractural agreement with the Corps, in part for certain structural modifications to the proposed dam to permit its use as a conduit for the transport of waters to other regions.

After a bonding proposal in support of that plan was defeated by a popular vote of the state's citizens, the TWDB requested that the Corps delete all further consideration of that plan in the future planning for the Cooper project. If at some future time the implementation of a revised water plan becomes definite, in such respect and with such cooperative agreements as would permit the use of the lake as a conduit, the environmental statement would be supplemented or revised as necessary to disclose the effects of that usage.

General Land Office
AUSTIN, TEXAS 78701
BOB ARMSTRONG, COMMISSIONER

PLANNING PROGRAM
1700 North Congress
Austin, Texas 78701
(512-475-6332)

August 11, 1976

Mr. H. Anthony Breard, Coordinator
Natural Resources Section
Budget and Planning Office
Office of the Governor
Austin, Texas 78701

Subject: Draft Environmental Statement: Cooper Lake and Channels, Texas

Dear Mr. Breard:

(1) Our review of the above-cited project has been completed and there are no objections by this office to the implementation of the Cooper Lake plans. However, it has come to our attention that the past and proposed channelization has and will create changes which will affect the State-owned streambeds.

(2) Since the State retains ownership of the by-passed streambed when straightening of the channel occurs, the General Land Office must maintain a record of any man-made alterations to the natural streambed. It is requested that the U. S. Army Corps of Engineers provide the General Land Office with information locating the natural streambed of the Sulphur River downstream from the Franklin and Hopkins County boundary line where the channel alterations have occured and where they are proposed.

Thank you for the opportunity to comment on this proposed project.

Sincerely,

Bob Armstrong

Bob Armstrong
Commissioner

(1) Noted.

(2) Channel work conducted by the Corps in the early 1950's and in 1971 in this area is included on new plates in the supplemental EIS. No further channel alternations are proposed in the supplemental EIS.

APPENDIX B

FISH AND WILDLIFE COORDINATION AND MITIGATION PLANS

APPENDIX B

FISH AND WILDLIFE HABITAT MITIGATION

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APPENDIX B

FISH AND WILDLIFE HABITAT MITIGATION

Introduction

The Cooper Lake and Channels project under consideration in the Final EIS filed June 24, 1977, and in this supplement was authorized in 1955. Since that time, the importance of recognizing and giving equal consideration to fish and wildlife resources in project planning and construction has increased considerably.

Emphasis in the past was placed on game species, commercial value, and the man-day or user approach to determine fishery and wildlife losses. Project induced losses seldom could be mitigated economically, so were simply charged to the cost of the project.

The new emphasis for fish and wildlife habitat planning is to relate the losses to productivity relationships between all wildlife and the quantity and quality of habitat that supports them. Proposed Department of Interior regulations (developed in response to President Carter's Water Policy memorandum, July 12, 1978) rely heavily on a habitat based evaluation for determining project induced losses and appropriate mitigation recommendations. The Corps must determine justifiable mitigation features to be included in a project, based on the recommendations of the responsible fish and wildlife agencies, and a reasonable balance between economic, environmental, and engineering considerations to optimize the total benefits in the public interest.

Mitigation Chronicle and Coordination

Coordination with the US Fish and Wildlife Service (USFWS) and the then Texas Game and Fish Commission on the authorized project began in 1957. In a report dated 17 May 1957, the USFWS stated that a cursory field examination had been made and that the findings must be considered preliminary in nature and that a more detailed report would be required at a later date. The preliminary report revealed that the streams involved frequently go dry in summer, except for a few of the deeper holes, and in general provide poor fish habitat. Also, the woodlands bordering the streams were felt to provide low to moderate value habitat for several small game species and the project area was found to provide a limited amount of hunting and fishing for local residents. The report stated that expected changes in fish and wildlife habitat caused by the proposed levee and channel work will result in only small losses to these resources. The Texas Game and Fish Commission had no comments.

In a letter report dated 13 July 1966, the USFWS recommended, among other things, that the Texas Parks and Wildlife Department (TPWD) be given the opportunity of selecting and administering a suitable tract of project lands for wildlife management and that the 1,200 acres of reservoir lands proposed for easement acquisition be acquired in fee title as mitigation for project-induced losses of wildlife habitat.

The TPWD concurred with the USFWS report. On 4 October 1966, the Corps of Engineers indicated to the TPWD that that agency would be given the opportunity of selecting and administering a suitable tract of project lands for wildlife management. On 6 October 1966, the Corps informed the USFWS of this and indicated that the 1,200 acres of reservoir lands proposed for easement acquisition would be acquired in fee title. This information was contained in Section IV of the Final EIS filed 24 June 1977, which additionally stated: "Within the fee title taking line for the reservoir, approximately 6,000 acres of land, in addition to the 3,300 acres dedicated to general recreation development, lie outside the water supply pool. This area, or a portion of it, could be dedicated to fish and wildlife purposes, provided a detailed management plan was submitted to and approved by higher authority.... The 1,200 acres of reservoir land originally proposed for easement acquisition have already been acquired in fee as part of the project required land purchase. This area is part of the 6,000 acres referred to .... above."

By a letter dated 14 October 1971, the Corps requested the USFWS to reevaluate the project impacts for the purpose of developing an environmental impact statement. In a letter report dated 8 March 1972, the USFWS indicated opposition to further channelization of the Sulphur River as then authorized because of the substantial losses to the fish and wildlife resources and associated amenities. No mention was made of further mitigation measures, but it was indicated that emphasis should be given to developing alternatives which lessen the adverse environmental impact of the project below Cooper Dam. In consideration of the opposition to further channelization, the alternative plan, "Reservoir and Levees," was selected and was recommended for implementation in the Final EIS, thus reducing the amount of remaining channelization by 80 percent.

In a letter dated 27 October 1975, the TPWD requested that a restudy be made to update earlier fish and wildlife reports and establish current impacts of the project on fish and wildlife resources. In a letter dated 2 December 1975, the USFWS agreed that a restudy should be initiated, indicating that their previous report of 13 July 1966 was inadequate. In similar responses to these agencies, dated 14 November 1975 and 13 February 1976, the Corps indicated that to the extent practicable, it would incorporate any additional information provided by these agencies before completion of the final environmental statement. It was further emphasized, however, that the environmental statement would contain an objective estimate of project-induced impacts on fish and wildlife resources, as determined by its biological consultants and in-house environmental staff.

On 10 June 1976, the draft environmental statement was coordinated for review and on 31 July 1976, a public meeting was held on the campus of East Texas State University in Commerce, Texas, to provide wider exposure and consideration of the statement. Of the nearly 630 people in attendance at the meeting, 55 delivered oral statements. Those who presented statements included two members of the US House of Representatives; a representative of the Governor of Texas; various state senators and representatives; representatives of various state agencies, state institutions, and environmental/conservation groups; landowners, and other public interest groups. Nearly unanimous support of the total authorized plan was evidenced at the meeting. Of the 55 speakers at the meeting, only three (Edward C. Fritz, Chairman of the Texas Committee on Natural Resources; Howard Saxion, Inland Conservation Chairman of the Lone Star Chapter of the Sierra Club; and Leland Wommack, resident of the Sulphur River Basin) expressed opposition to one or more features of the authorized plan. Through the oral testimony given at the public meeting and the written statements of comment submitted during coordination, two distinct issues surfaced: (1) the need for an adequate supply of surface water and downstream flood control, as stressed by area residents and governing bodies; and (2) the opposition to a channel as a means of providing downstream flood control, as stressed by environmentally concerned agencies, groups, and individuals. Based on these observations, the decision was made to modify the plan to eliminate most of the uncompleted channel work as discussed previously.

The period of commenting on the draft environmental statement ended on 11 August 1976; however, extensions were granted to the USFWS and the State of Texas. On 15 September 1976, the USFWS transmitted its 3 September 1976 report with eight recommendations as described above in another USFWS comment. Among the recommendations was one to seek congressional authorization to purchase approximately 42,900 acres of compensation lands, an increase of 41,700 acres beyond the 1966 determination. The TPWD generally concurred with the USWFWS report, except that agency noted that an actual acreage figure for mitigation had not yet been determined and was subject to negotiations among the various agencies concerned. This report was received at the time when the environmental statement was being compiled in final form.

The preparation of a comprehensive mitigation report, with appropriate interagency participation, is fundamental to any attempt to acquire authorization and funding of a mitigation program such as that which had been proposed. At the time, it was estimated that preparation of the report and securing the necessary authorization would require a minimum of two years. In view of the previous coordination with the USFWS and the TPWD and the adoption of their previous mitigation recommendations and in view of the delay in the project which would have resulted had the final environmental statement been delayed so that an interagency mitigation report could have been incorporated into it, it was decided to proceed with the completion of the statement absent the interagency mitigation report. However, it was also

decided that such a report would be prepared as required by the Fish and Wildlife Coordination Act of 1958 and that it would be submitted to Congress for authorization prior to impoundment of water in the Cooper Lake. This decision and commitment were contained in Section V of the Final EIS and in the Statement of Findings.

Coordination on the mitigation report began in January 1977 when the USFWS was requested to furnish base data used in its 3 September 1976 report, and continued into February and March 1977. The Final EIS was filed with the President's Council on Environmental Quality on 24 June 1977. The Corps and USFWS personnel met on 3 November 1977 to discuss the work to be done on the mitigation report. It was agreed that some additional interagency field work would be required but that every effort would be made to utilize as much of the data from the 3 September 1976 report as possible. The Corps of Engineers proposed a broad schedule for the study lasting about 1-1/2 years which was acceptable to all present. The field work was delayed until the new spring growth in the basin had begun and until weather conditions would allow access to the previous sample sites. The interagency field survey was conducted on 17 through 20 April 1978 by representatives of the Corps of Engineers, the USFWS, and the TPWD. By letter dated 2 May 1978, the Corps of Engineers proposed a method by which to establish the data base for the mitigation report which has been accepted by the USFWS and the TPWD. Additional interagency field trips were conducted 19-21 June 1978 and 10-13 July 1978 to establish basic data for use in terrestrial and aquatic habitat evaluation procedure (HEP) analyses.

After the permanent injunction was issued for the Cooper Lake and Channels project on December 8, 1978, further analysis of mitigation needs was delayed pending reaction to the deficiencies listed in the Memorandum Opinion. In March 1979, the Corps provided the USFWS with a new schedule for responding to deficiencies in the EIS, including the mitigation issue. Between May and August of 1979, various agreements were reached between the Corps of Engineers and the USFWS on project features and loss assumptions to be used in the HEP analysis of the Reservoir and Levees plan, and other alternatives to be evaluated in the Supplemental EIS. Additional interagency field trips were conducted 13-15 August 1979, 28-29 November 1979, and 19-22 February 1980.

Due to the need to finalize compensation requirements and mitigation plans, and correct other deficiencies in the Final EIS as expeditiously as possible, it was agreed that the USFWS would provide planning aid letters documenting results of analyses of habitat gains, losses, and compensative requirements for alternatives under consideration in the Supplemental EIS. The recommendations in these planning aid letters have been used to develop compensation requirements for alternatives under consideration in the Supplemental EIS, and to recommend a mitigation plan for the alternative selected for recommendation. Eleven formal letters have been received from the USFWS during 1979 and 1980, documenting coordination and providing data for use by the Corps in

preparing the Supplemental EIS. Numerous meetings were conducted, and coordination with the TPWD has also been conducted through meetings and correspondence during this period.

Development of Mitigation Plans

Decisions concerning the mitigation of fish and wildlife losses must usually be made bearing in mind four interrelated factors: (1) biological data on existing resources and their productivity, the projected future of those resources, and probable impacts on those resources; (2) economic considerations of man's use of the resource and costs involved for acquisition, development, and management of mitigation features; (3) societal preferences and impacts on other related resources and resource use by man; and (4) political realities inherent in water resource planning and land use. The first two involve scientific procedure, the second two policy decisions.

The first consideration can be addressed by the HEP methodology. Mitigation (or compensation, which means complete or full mitigation) should first be based on replacing the resource base, and not the resource's use by man. Increased productivity of unaffected lands by acquisition and management or other means is important to replace losses in productivity caused elsewhere by a given alternative. The degree to which various mitigative measures compensate for lost productivity can be determined by HEP, and full compensation plans in a strictly biological sense can be developed.

The second consideration can also be determined in part by relating fishery and wildlife productivity gains and losses developed by HEP to the economic worth of these resources to man. This involves both consumptive (sport hunting, fishing, trapping, commercial), and non-consumptive utilization (bird watching, nature study, other forms of wildlife oriented recreation). The cost to achieve compensation for biological losses must also be a consideration in the development of mitigation plans in the public interest.

The third and fourth considerations are the most difficult to obtain data for and quantify, but in the end are usually the determining factors in implementing mitigation plans. Societal preferences and political considerations are determined in part by land use trends and plans; public comment and public meetings; public laws, regulations, and policies on resource use; and acceptability to local interests.

Terrestrial HEP

Initial interagency field studies were done to collect data for and evaluate three habitat types (bottomland hardwood, semiwooded, and open land) in terms of quality for a list of 10 species. In later use of these field data for the HEP analysis, it was agreed

between agencies that some of the species used in evaluation of the quality of habitats were not indicator species of certain habitats and should be deleted. The list of species used was adjusted to each habitat type accordingly, and the average quality of the habitat based on initial values applied by the field team was also adjusted. Species used are listed in Table 1. Habitat unit values for field sample sites are listed in Table 2.

TABLE 1

TERRESTRIAL HEP SPECIES LIST

Evaluation Element	Habitat Type: Bottomland Hardwood (BLHW)	Habitat Type: Semiwooded Land (SW)	Habitat Type: Open Land (OL)	Species Importance
Three-toed Box Turtle	*	*	*	Food Chain
Red Shouldered Hawk	*	*	*	Esthetic, Rodent Control, Predator
Yellow-crowned Night Heron	*			Esthetic, Predator
Wood Duck	*			Rare, Esthetic
Bobwhite Quail		*	*	Game Species
Cotton Rat		*	*	Food Chain, Prey Species
Raccoon	*	*	*	Commercial, Game
Grey Squirrel	*			Game, Sensitive Species
White-tailed Deer	*	*	*	Game, Monetary, Esthetic
Bobcat	*	*		Commercial, Game, Predator

* Indicator species.

TABLE 2

EXISTING HABITAT UNIT VALUES AND NUMBER OF SAMPLE SITES

Habitat	Number of Sample Sites	Habitat Unit Value (HUV) (scale 1-100)
Bottomland Hardwood (BLHW)	7	68
Semiwooded Land (SW)	6	48
Open Land (OL)	6	33

The quantity of each habitat type multiplied by the quality value gives a relative indication of the health of the total habitat within the study area for the indicator species at any given point in time. Relative changes in the habitat units due to impacts of given alternative plans can then be calculated over time and compared to the existing quantity and quality of habitat projected over the same period of time. This procedure gives the alternatives' impacts on wildlife resources.

The quantity of each habitat type potentially affected by the four final plans under consideration in the Supplemental EIS are shown in Table 3. Assumptions on habitat quantity and quality changes for each project component of each alternative over the 100-year evaluation period were agreed on by the Corps of Engineers and USFWS. Utilizing the above data in the terrestrial HEP analysis results in a total number of Habitat Units which must be compensated for to offset the wildlife productivity lost through habitat changes in quality and quantity. To obtain an appropriate acreage of land which could be acquired and managed to achieve equal compensation for each habitat type requires further assumptions on the time required to bring a given habitat type up to a more productive condition to compensate for lost productivity on the affected habitat. Table 4 displays this process for the bottomland hardwood habitat type, Reservoir Only plan. Similar determinations were made for each habitat type and each alternative.

In order for the net lost wildlife productivity from each alternative to be compensated, the required acreage of each in-kind habitat type must be raised in productivity from its existing quality. This can be done passively through natural succession processes by removing existing grazing and other land management practices which keep the habitat value at its current level, or by applying development practices to the land to actively increase the habitat value. Public acquisition and removal of economic land use practices has been determined by the USFWS to result in a gradual increase in habitat value from 68.0 to 80.0. This requires essentially no development (other than fencing), but requires a relatively long period of time. Applying a mid-level initial development to bottomland hardwoods, semiwooded habitat, and open lands after

TABLE 3

HABITAT TYPE IN ACRES, POTENTIALLY AFFECTED BY PROJECT ALTERNATIVE AND COMPONENT
COOPER LAKE AND CHANNELS PROJECT, TEXAS

	Reservoir and Levees			Reservoir Only			Water Supply Only			Nonstructural		
Project Component	BLHW	SW	OL	BLHW	SW	OL	BLHW	SW	OL	BLHW	SW	OL
Water Supply Pool	5,905	5,800	7,600	5,905	5,800	7,600	5,905	5,800	7,600	-	-	-
Perimeter Clearing	291	112	717	291	112	717	291	112	717	-	-	-
Flood Control Pool	602	232	1,481	602	232	1,481	-	-	-	-	-	-
Damsite & Spillways	55	155	200	55	155	200	55	155	200	-	-	-
Dam Borrow Areas	150	145	190	150	145	190	150	145	190	-	-	-
Outlet Channel	8	7	10	8	7	10	8	7	10	-	-	-
Recreation Areas	858	330	2,112	858	330	2,112	-	-	-	24,200	-	-
Fee Take Line	790	304	1,946	790	304	1,946	195	75	460	-	-	-
Total, Habitat	8,659	7,085	14,256	8,659	7,085	14,256	6,604	6,294	9,177	24,200		
Total, Project		30,000			30,000			22,075			24,200	
Levees & Channels												
Total, Habitat	600	85	115	-	-	-	-	-	-	-	-	-
Total, R.O.W.		800			-			-			-	
Downstream Res. Flood Protection	3,200	1,500	8,200	3,200	1,500	8,200	-	-	-	-	-	-
Downstream L&C Flood Protection	8,700	1,800	900	-	-	-	-	-	-	-	-	-
3 Year Flood Plain (Voluntary Land Use)	-	-	-	-	-	-	-	-	-	56,300	6,600	3,300
3-30 Year Flood Plain (Voluntary Land Use)	-	-	-	-	-	-	-	-	-	3,200	3,000	12,900
Total, Habitat	11,900	3,300	9,100	3,200	1,500	8,200	-	-	-	59,500 1/	9,600	16,200
Total, Protected Area		24,300			12,900			-			85,300	

1/ Includes 24,200 acre recreation corridor.

TABLE 4

HEP ANALYSIS - BOTTOMLAND HARDWOODS
RESERVOIR ONLY ALTERNATIVE

Project Component	Acres Affected	Loss Assumption HUV	Year
Water Supply Pool	5,905	68 to 0	1990
Dam and Spillway	55	68 to 0	1990
Borrow Area	150	68 to 0	1990
Outlet Channel	8	68 to 0	1990
Perimeter Clearing	291	68 to 0	1990
Downstream Area Protected (induced clearing)	2,560	68 to 0	1990
Subtotal	8,969		
Flood Pool	602	68 to 80	1990-2089
Fee Take Line	790	68 to 80	1990-2089
Recreation Area	858	68 to 80	1990-2089
Subtotal	2,250		
Open Land on Project Succession to Wooded	2,475	0 to 80	1990-2089

Project Loss Determination

Change in Habitat Units = quantity x quality x time

Loss = 8,969 x 68 x 100 years (annualized)

Gain = 2,250 x 12 x 100 years (considers succession time & annualization)

Gain = 2,475 x 80 x 100 years (considers succession time & annualization)

Net Loss = -413,489 annualized habitat units

Compensation Determination

Quantity of Compensation Lands Required = $\frac{\text{Net loss in habitat units (annualized)}}{\text{Gain in quality with management (annualized, and considers succession time)}}$

21,424 Acres = $\frac{\text{-413,489 annualized habitat unit loss}}{\text{(90-68 adjusted for time of succession)}}$

public acquisition will increase the value of the habitat at a faster pace than natural succession. Based on some water hole development, vegetative plantings and selective clearing to open up dense stands of woods, the average cost per acre to develop acquired habitat to a value of 90.0 is about $62/acre for bottomland hardwoods, $65/acre for semiwooded, and $150/acre for open habitat (1974 price levels). To develop these habitats to the full 100.0 value would require about $187/acre for bottomland hardwoods, $193/acre for semiwooded, and $391/acre for open habitat. Tables 5 and 6 show how these average values were derived.

Compensation acreages for each plan based on various development assumptions are displayed in Table 7. These terrestrial compensation acreages are the scientifically determined requirements for replacing biological productivity, and are the first consideration in developing a mitigation plan. Table 4 displays how the compensation acreage required was calculated for bottomland wooded, Reservoir Only plan, at the 90.0 HUV level of development.

Based on average operation, maintenance, and management costs at State operated wildlife management areas in similar habitat types in Texas and Arkansas, it is expected that $3/acre/year would be required to administer and maintain the productivity of acquired compensation lands to the level achieved by initial development or natural succession.

Applying these costs for various levels of management of compensation lands needed for the four alternatives under consideration in the Supplemental EIS indicates that while substantially less land is required for compensation with intensive initial development (to 100.0 HUV), costs for development are high. Conversely, with low development costs, substantially more land must be acquired to offset lost productivity. Economic evaluation of full compensation to target levels of 80.0 HUV, 90.0 HUV, and 100.0 HUV on acquired lands was done for each alternative. Using development cost in Table 6, and estimating fencing cost, land acquisition cost, and O&M cost based on acreage required for various compensation levels, acquisition to a 90.0 HUV can be shown to be the most economically efficient option in terms of average annual charges, though assumed development and management of a 100.0 HUV level is closely competitive. Reaching 100.0 HUV level is theoretically possible, but in actuality it probably cannot be reached on a management area for all habitat types and species. Acquisition with development and management to achieve a habitat value of 90.0 is therefore a reasonable trade-off between the two extremes, is economically efficient, and is used in comparison of alternatives for purposes of estimating benefits and costs for terrestrial habitat compensation.

TABLE 5

COMPENSATION AREA DEVELOPMENT COSTS (JULY 1974 PRICES)

Water Hole Development

Habitat Type	Target HUV 80.0	90.0	100.0
BLHW	None	3-0.5 acre ponds/section	9-0.5 acre ponds/section
SW	None	3-0.5 acre ponds/section	9-0.5 acre ponds/section
OL	None	3-0.5 acre ponds/section	9-0.5 acre ponds/section

$12,900 per pond x 3 ponds per section ÷ 640 acres = $60/acre average to achieve 90.0 HUV
$12,900 per pond x 9 ponds per section ÷ 640 acres = $181/acre average to achieve 100.0 HUV

Clearing and Thinning

Habitat Type	80.0	90.0	100.0
BLHW	None	3-1.0 acre tracts/section	8-1.0 acre tracts section
SW	None	None	None
OL	None	None	None

$450 per tract x 3 tracts ÷ 640 acres = $2/acre average to achieve 90.0 HUV
$450 per tract x 8 tracts ÷ 640 acres = $6/acre average to achieve 100.0 HUV

Vegetative Plantings

Habitat Type	80.0	90.0	100.0
BLHW	None	None	None
SW	None	None	None
OL	None	50 acres/section	115 acres/section

$1,100 per acre x 50 acres ÷ 640 acres = $85/acre average to achieve 90.0 HUV
$1,100 per acre x 115 acres ÷ 640 acres = $198/acre average to achieve 100.0 HUV

Ground Denning Areas

Habitat Type	80.0	90.0	100.0
BLHW	None	None	None
SW	None	2 areas/section	5 areas/section
OL	None	2 areas/section	5 areas/section

$1,600 each x 2 areas ÷ 640 acres = $5/acre average to achieve 90.0 HUV
$1,600 each x 5 areas ÷ 640 acres = $12/acre average to achieve 100.0 HUV

TABLE 6

TOTAL AVERAGE DEVELOPMENT COST PER ACRE TO REACH TARGET HUV

	TARGET 90.0 HUV			TARGET 100.0 HUV		
	BLHW	SW	OL	BLHW	SW	OL
Water Hole Development	$ 60	$ 60	$ 60	$181	$181	$181
Clearing and Thinning	$ 2	None	None	$ 6	None	None
Vegetative Plantings	None	None	$ 85	None	None	$198
Ground Denning Areas	None	$ 5	$ 5	None	$ 12	$ 12
Total	$ 62	$ 65	$150	$187	$193	$391

Potential Compensation Areas

Two broad areas in the upper and lower Sulphur River drainage were identified as having the best potential for containing the in-kind habitats required to compensate fully for identified terrestrial habitat losses. These are shown in Figure 1. One of these consisted of about 20,000 acres of land in two parcels upstream and downstream of lands required for Cooper Lake and adjacent to the South Sulphur River, and upland areas adjacent to project lands on the south side of Cooper Lake. The other area consisted of about 81,000 acres adjacent to the Sulphur River and White Oak Creek between Highway 37 and Wright Patman Lake project lands.

The upper basin area contains about 10,000 acres of wooded bottomlands which was not sufficient to compensate at any management level, but did contain open and semiwooded habitat in upland and bottomland areas which could be used for compensation purposes. The area in the lower basin contains sufficient bottomland hardwoods to compensate at differing management levels, but semiwooded habitat is almost nonexistent in these areas. Since a larger, contiguous management area could be defined in the larger lower basin area, this area was selected by USFWS as the primary area for developing terrestrial compensation plans. Furthermore, land costs are somewhat lower in this area than in the upper basin, a substantial portion of the lands under consideration were already encumbered by a flowage easement at Wright Patman Lake, the TPWD is pursuing the lands at Wright Patman Lake for a wildlife management area, and the area is less developed agriculturally and populated less densely than the upper basin area. As a disadvantage, this area is located approximately 60 miles downstream in the Sulphur River Basin from where most project impacts on wildlife productivity will occur with the alternative plans.

TABLE 7

TERRESTRIAL HEP ANALYSIS
LANDS REQUIRED TO BE DEVELOPED AND MANAGED TO COMPENSATE FULLY FOR IN-KIND LOSSES FOR ALTERNATIVE PLANS

Habitat & Target HUV	Reservoir & Levees (Acres)	Reservoir Only (Acres)	Water Supply Only (Acres)	Nonstructural (Acres)
Bottomland Hardwoods				
(80) No Management	79,613	37,251	34,575	0 1/
(90) Mid-Management	45,788	21,424	19,885	0
(100) High Management	32,489	15,202	14,110	0
Semiwooded				
(80) No Management	13,395	10,255	9,475	17,562
(90) Mid-Management	10,919	8,359	7,723	14,316
(100) High Management	8,900	6,814	5,884	11,668
Open Land				
(80) No Management	0 1/	0 1/	4,441	0 1/
(90) Mid-Management	0	0	3,925	0
(100) High Management	0	0	3,369	0

1/ No compensation is needed. The portions of open land within the project fee take line of an alternative have been credited with succession to bottomland hardwood and semiwooded habitats over time. This credit is reflected in the net compensation for these two habitats where applicable.

Two alternative compensation areas were defined by USFWS within this broad lower basin area, one incorporating flood plain and associated uplands along the Sulphur River and the other along White Oak Creek. The Sulphur River area consisted of about 35,000 acres and the White Oak Creek area 33,400 acres. While each of these areas should compensate fully for identified habitat losses for the Reservoir Only plan, coordination with the USFWS and TPWD indicated a preference for the White Oak Creek area. This was primarily due to a better defined management area (bounded by several highways and not severed by IH 30), and the desire to preserve and utilize in management programs a number of ponds, sloughs, and rookery areas within the White Oak Creek area. Based on this interagency coordination, the USFWS subsequently recommended this 33,400 acre area as the primary area to be considered in compensating terrestrial wildlife habitat losses for the Reservoir Only plan. The recommended USFWS compensation area for the Reservoir Only plan is shown in Figure 2.

Full compensation for the Reservoir and Levees plan could be accomplished through acquisition and management of both the above identified areas (the Sulphur River and White Oak Creek areas). Net adverse habitat losses for bottomland hardwoods and semiwooded habitat for the Water Supply Only plan are similar to the Reservoir Only plan. However, the Water Supply Only plan also has a net adverse impact on open land habitats, raising the total in-kind compensation requirement slightly higher than the Reservoir Only plan. No specific compensation plan for the Water Supply Only plan was developed in planning aid studies, and since the plan involves no Federal action, actual mitigation is speculative. For purposes of evaluation and plan selection, however, certain assumptions were made regarding mitigation for the Water Supply Only plan. The nonstructural plan was determined to require no terrestrial habitat mitigation.

To achieve a 90.0 habitat value on these lands, initial development and management practices would have to be applied to fully compensate for terrestrial wildlife productivity. A typical area with application of these various development and management practices is shown in Figure 3, with details of an optimum development and management scheme shown in Figures 4, 5, and 6. In actual application, these practices would be applied in various combinations on differing habitat types during more detailed planning for a compensation area.

Evaluation of USFWS Recommended Habitat Compensation Plans

The USFWS recommended terrestrial habitat compensation area for the Reservoir Only plan consists of 4,400 acres of open habitat, 300 acres of semiwooded habitat, 22,700 acres of bottomland hardwoods, 6,000 acres of upland wooded habitat, and about 40 acres of water areas in sloughs and flood plain oxbow lakes. For the Reservoir and Levees plan, an additional area consisting of about 19,100 acres of bottomland hardwoods, 6,200 acres of open land, 100 acres of semiwooded habitat, and 6,700 acres of upland woods was recommended.

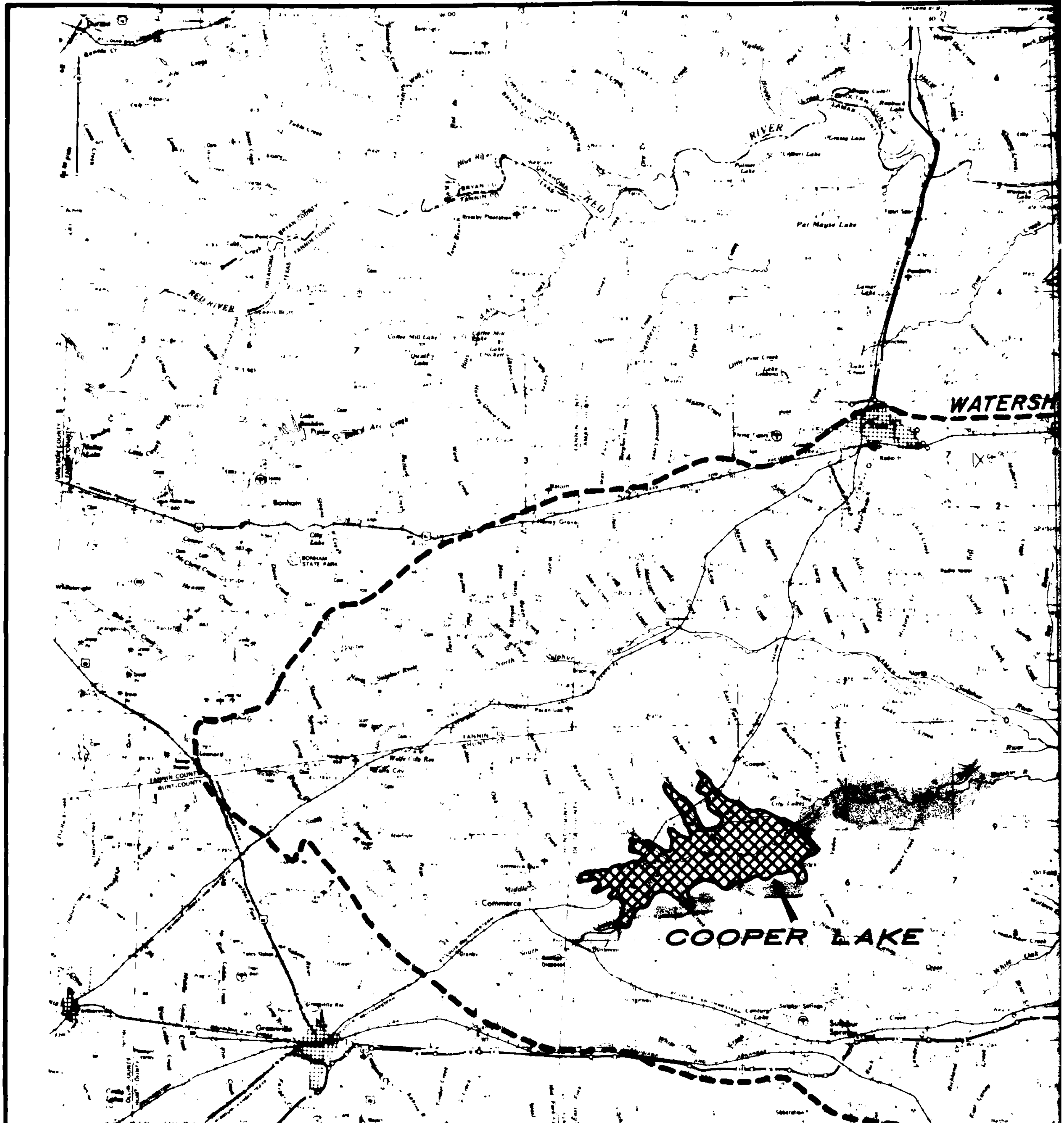
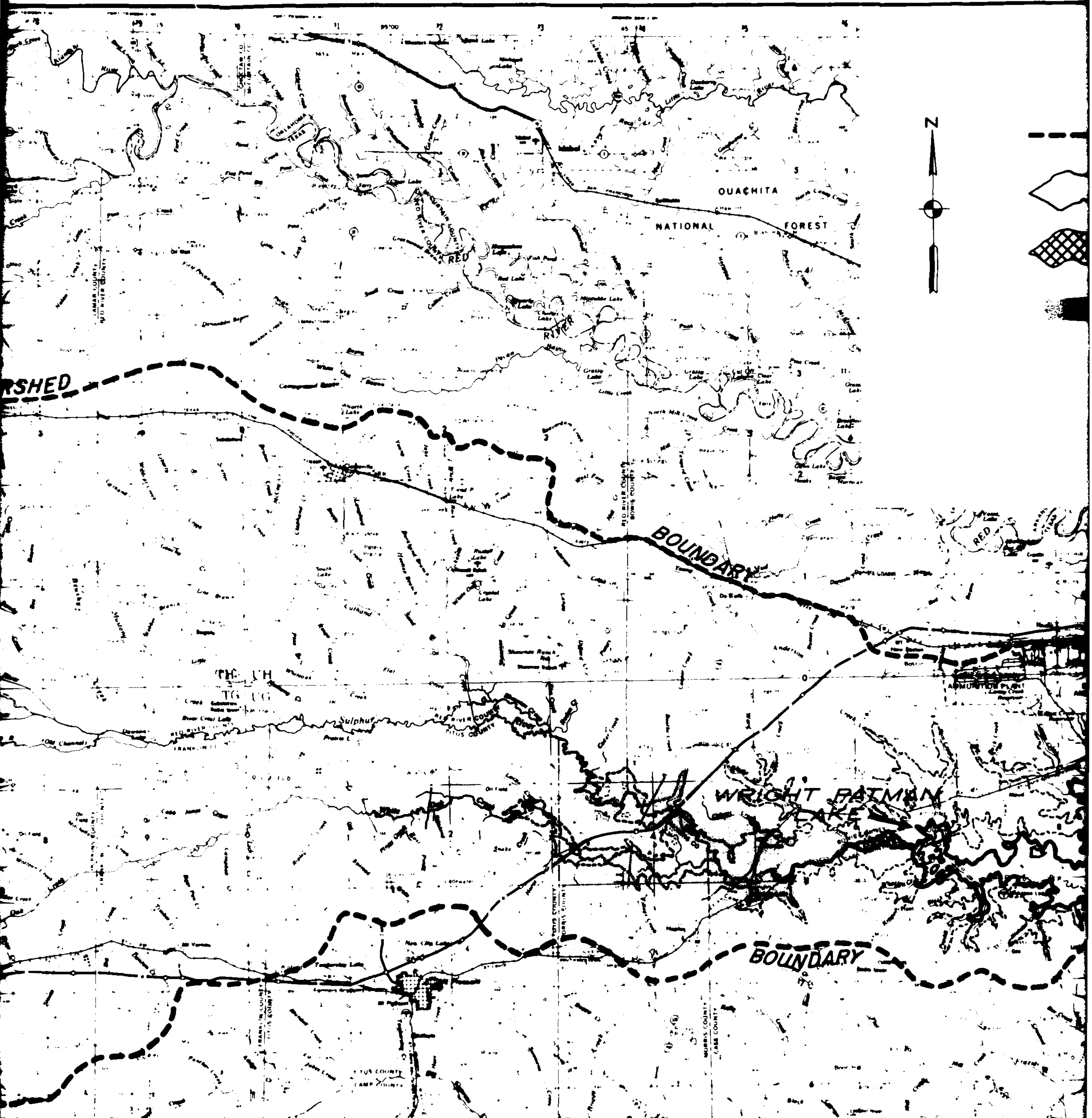
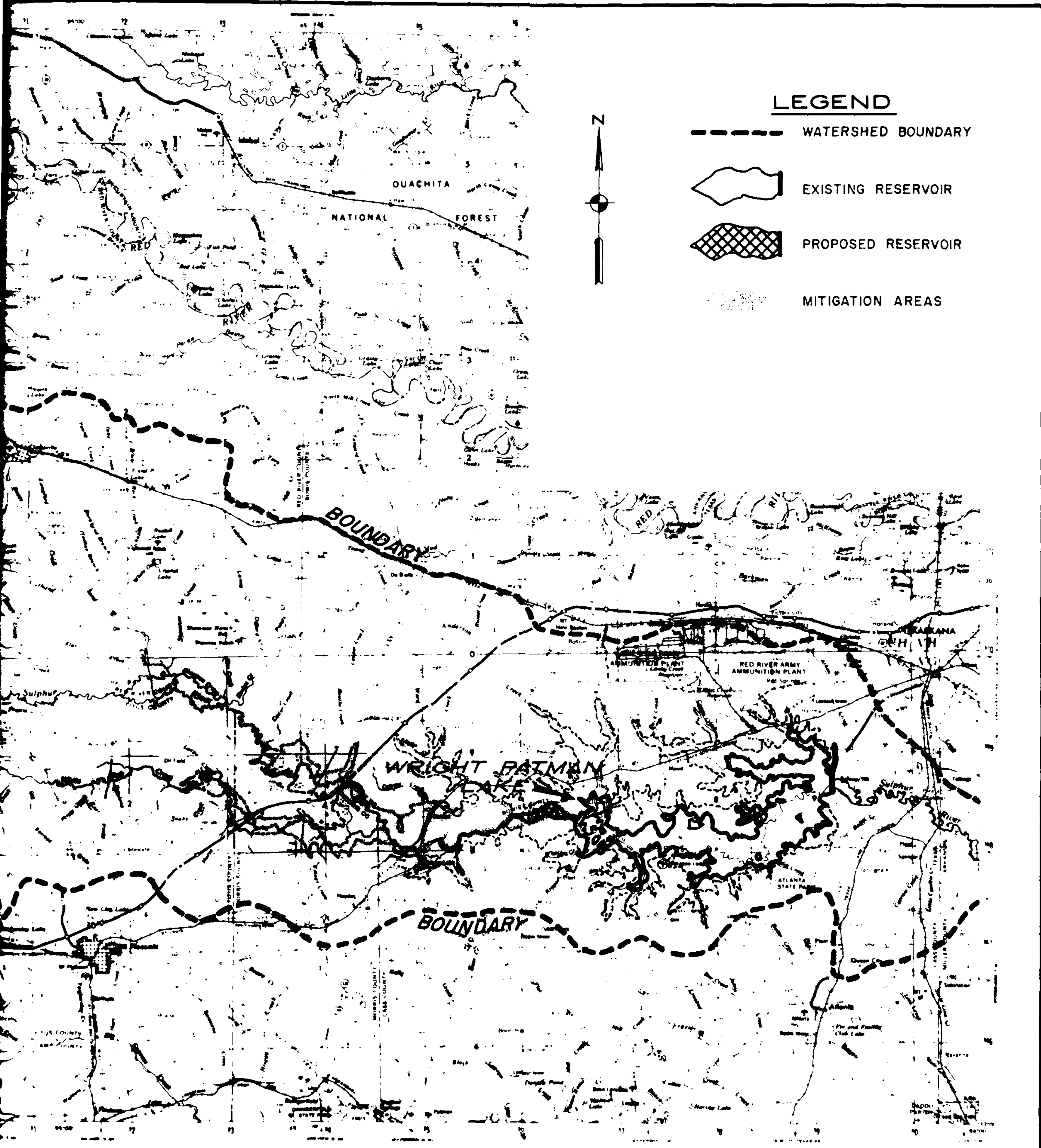


FIGURE I- POTENTIAL WILD



LDLIFE HABITAT MITIGATION AREAS INVESTIGATED



TIGATION AREAS INVESTIGATED

APPENDIX E

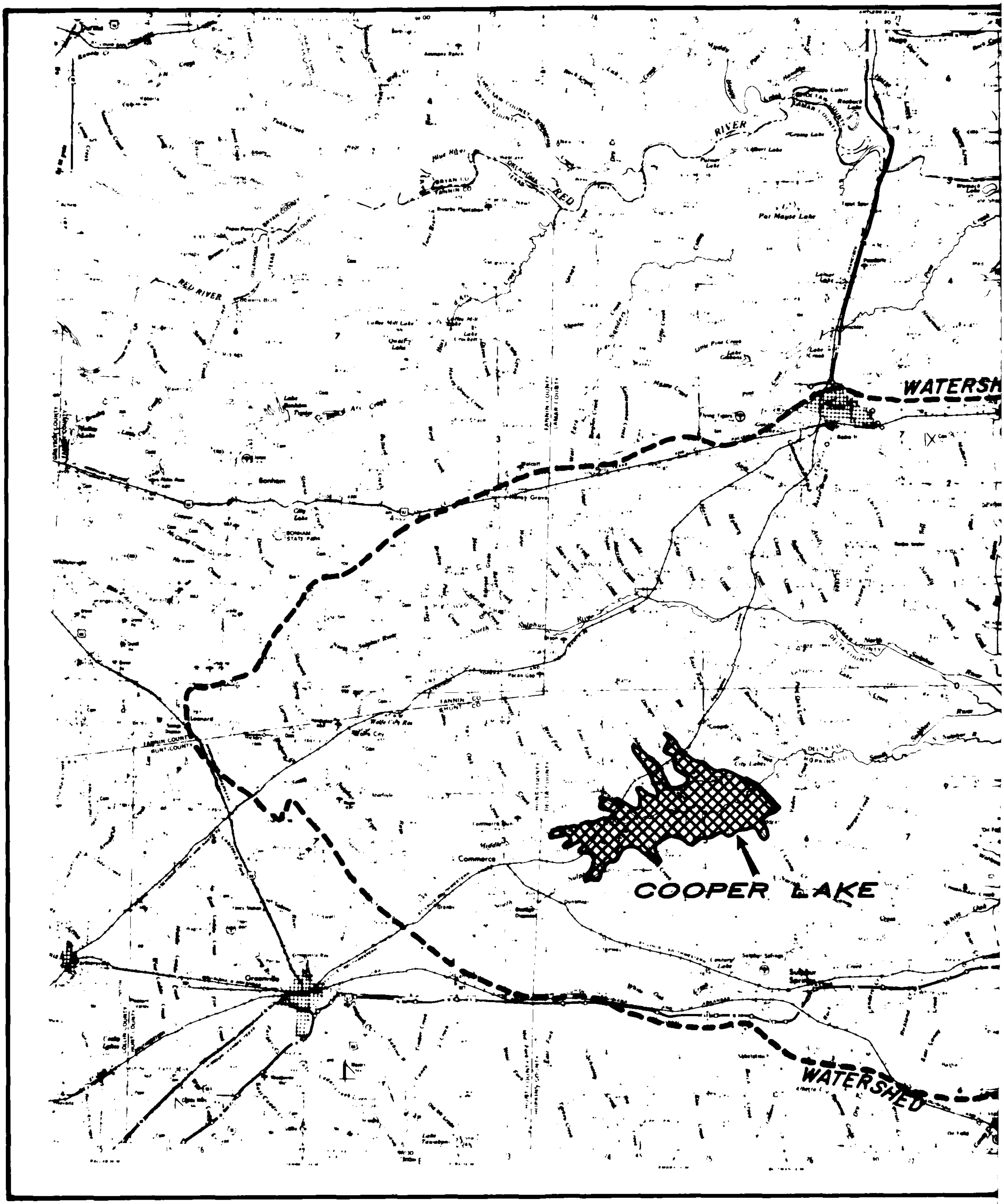
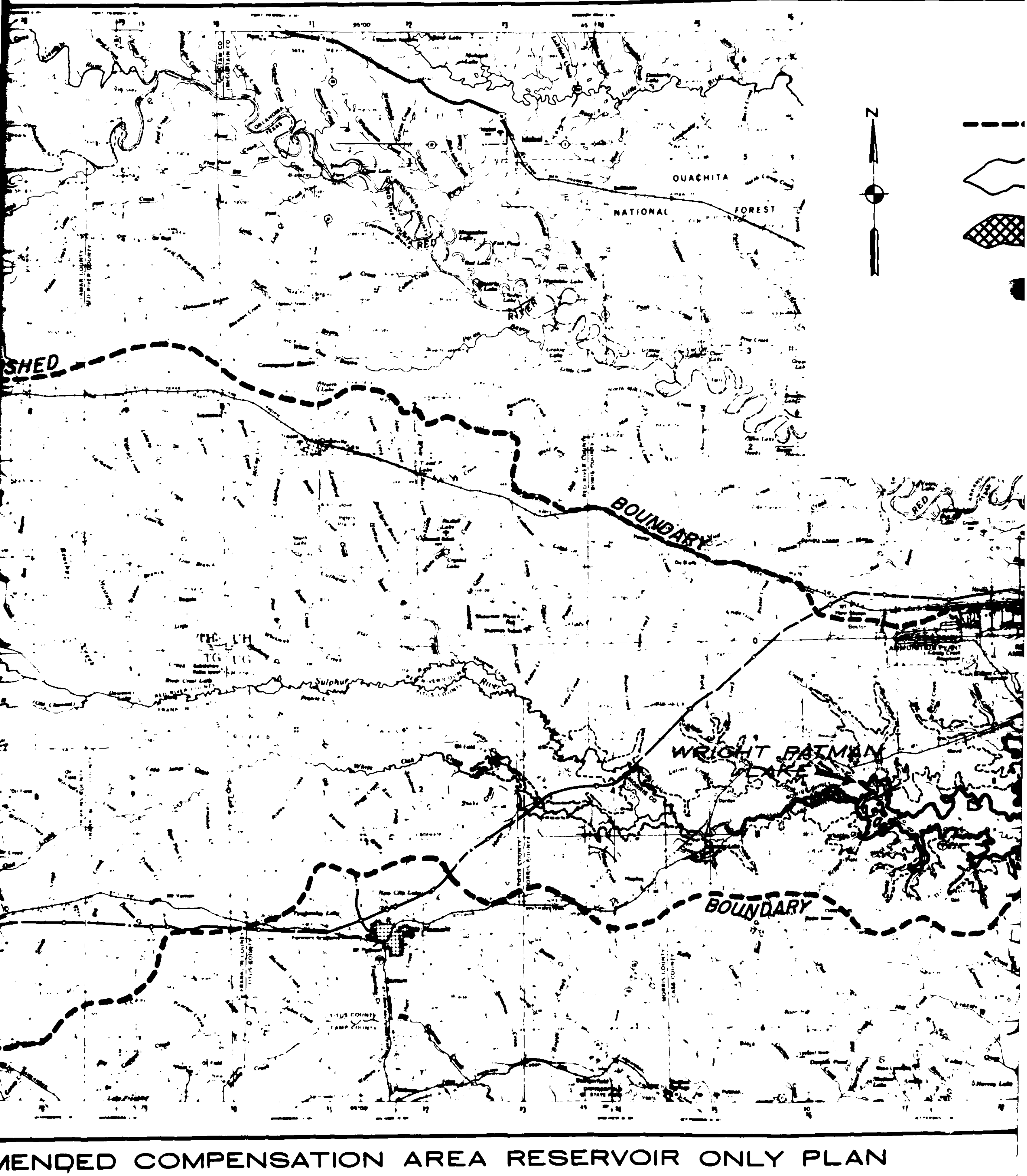
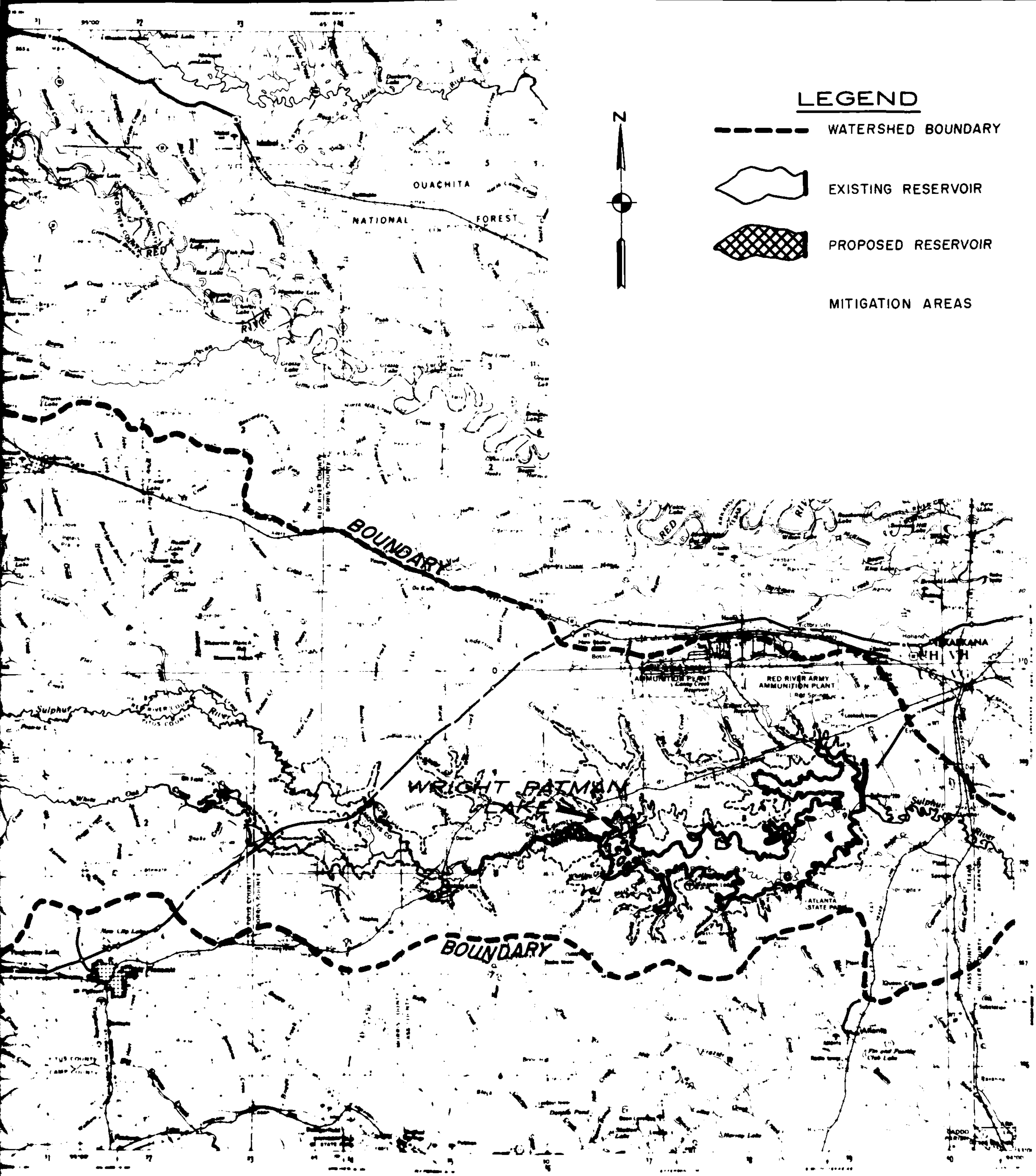


FIGURE 2-USF & WS RECOMME



MENDED COMPENSATION AREA RESERVOIR ONLY PLAN



ATION AREA RESERVOIR ONLY PLAN APPENDIX

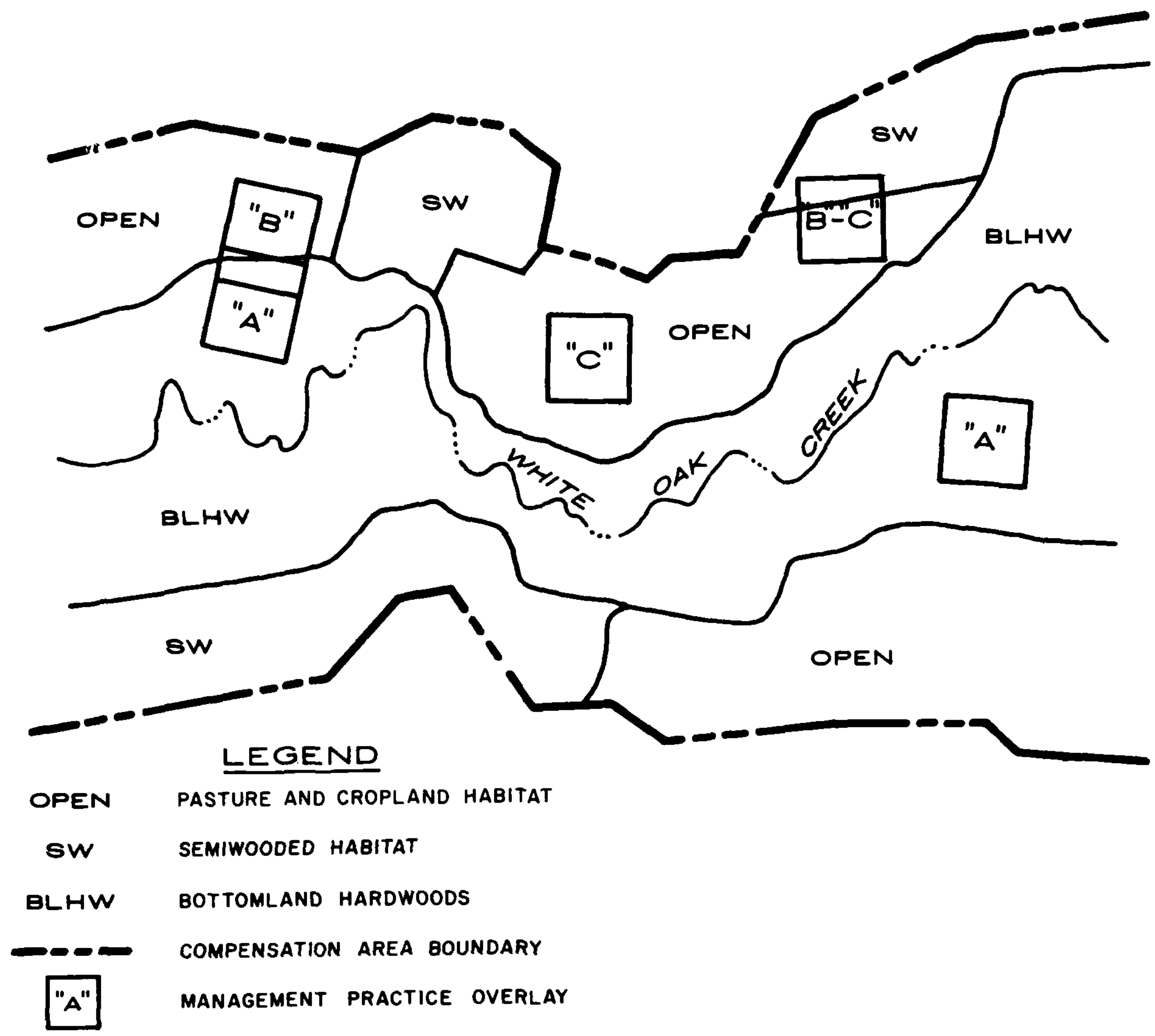


FIGURE 3 - TYPICAL APPLICATION OF HABITAT DEVELOPMENT AND MANAGEMENT PRACTICES

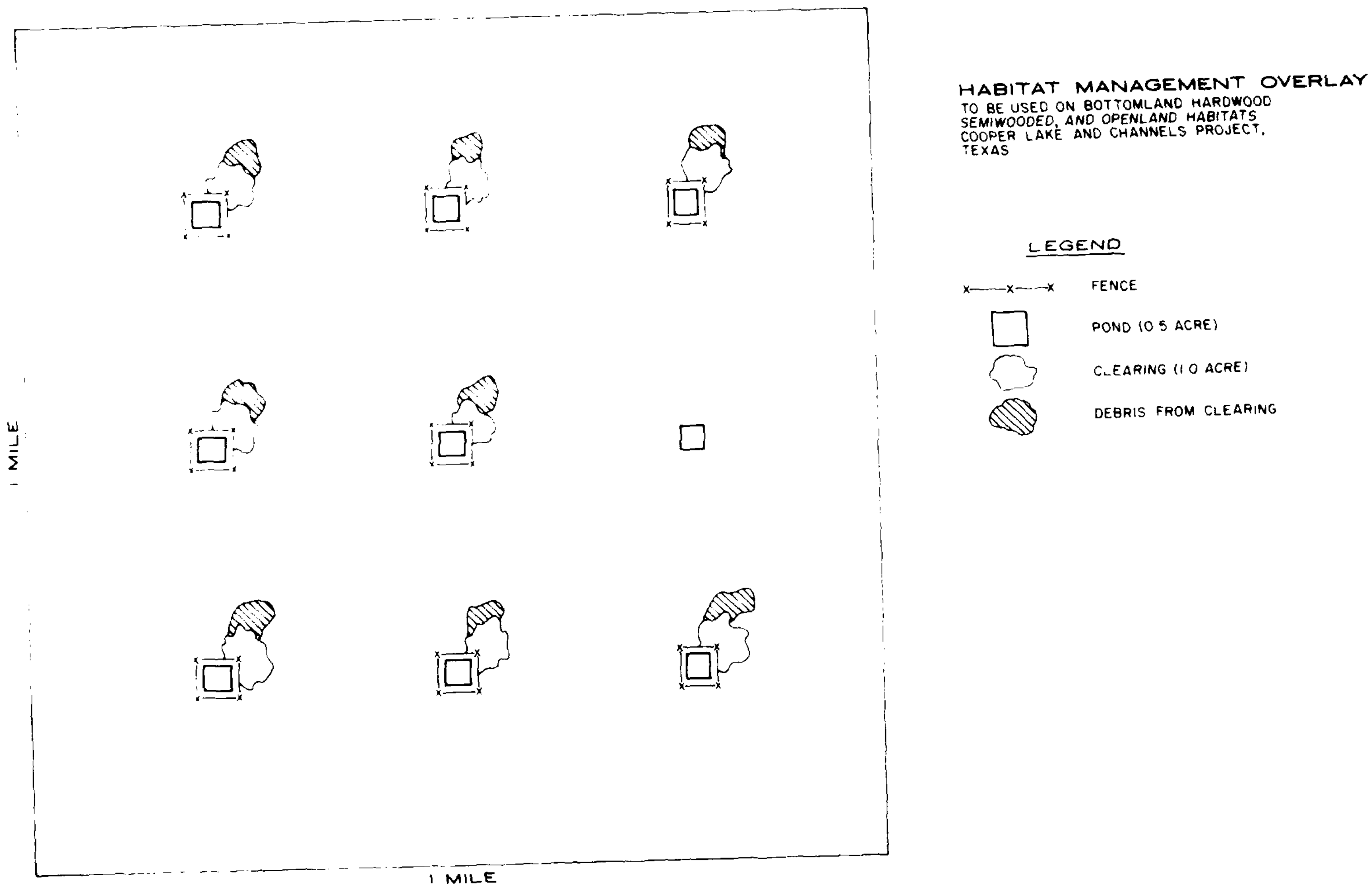
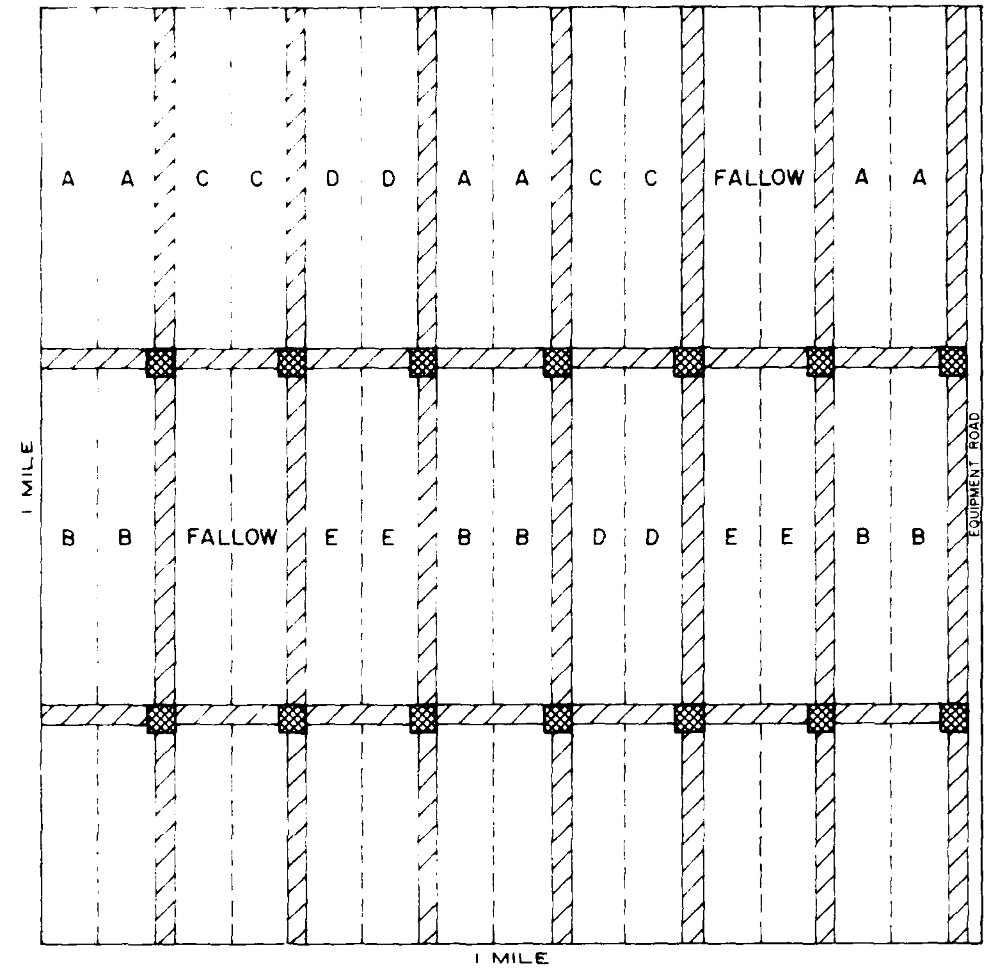


FIGURE 4
MANAGEMENT DETAIL "A"



HABITAT MANAGEMENT OVERLAY
TO BE USED ON SEMIWOODED AND OPENLAND HABITATS
COOPER LAKE AND CHANNELS PROJECT, TEXAS

LEGEND

BRUSHY TRAVEL LANE (104 FEET WIDE)

WOODY MOTT (156 FEET SQUARE)

A SMALL GRAIN

B SMALL GRAIN

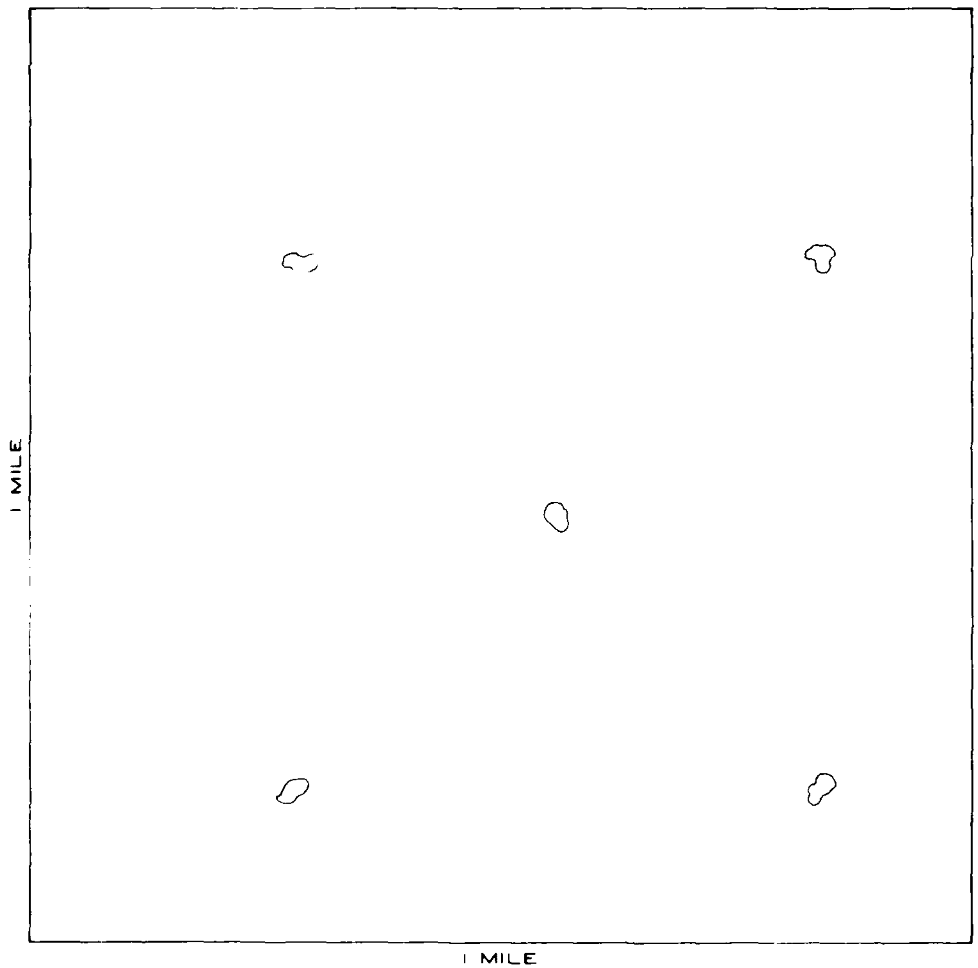
C SMALL GRAIN

D SMALL GRAIN

E SMALL GRAIN

UNHARVESTED STRIP (10 FEET WIDE)

FIGURE 5
MANAGEMENT DETAIL "B"



HABITAT MANAGEMENT OVERLAY
TO BE USED ON SEMIWOODED AND
OPENLAND HABITAT
COOPER LAKE AND CHANNELS PROJECT,
TEXAS

LEGEND

GROUND DENNING AREAS MADE FROM BRUSH/LOGS AND/OR PILED-UP EARTH AT SPATIAL SCALE INDICATED ACTUAL SIZE NOT TO SCALE

FIGURE 6
MANAGEMENT DETAIL "C"

The existence of wildlife is highly dependent on suitable habitat. From an ecological viewpoint, all habitat has value and the loss or modification of habitat results in biological productivity changes. These changes may be adverse or beneficial depending on man's perception or use of the resource that is gained or lost. Man's perception of values seldom corresponds to overall ecological balances.

From the aspect of replacing net biological productivity lost, the recommended compensation area for the Reservoir Only plan will compensate fully over the project life for the bottomland hardwood losses. There are only 280 acres of existing semiwooded habitat within the compensation area to offset a net identified loss of 8,359 acres of this habitat. However, there are 4,400 acres of open habitat not required to offset losses and 5,960 acres of upland hardwoods which are not an in-kind habitat evaluated in the HEP analysis. Each of these habitats have many of the same values and support the same species found in semiwooded habitat. Therefore, the combination of open, semiwooded, and upland wooded habitat found within the compensation area should also replace fully the net biological productivity lost on semiwooded habitat with the Reservoir Only plan. Similarly, the additional compensation area needed for the Reservoir and Levees plan should fully compensate for net adverse losses.

Important or significant habitats are generally characterized as those which are in short supply, those which support life stages of species of high interest to man such as game species or endangered species, or those which are disappearing or being reduced in value through ongoing land use changes. Within the two counties (Delta and Hopkins) impacted by the Reservoir Only plan, there are 128,878 acres of bottomland hardwoods, 66,573 acres of semiwooded habitat, and 431,105 acres of open land based on recent inventories compiled by the TPWD. Within the 30-year flood plain of the Sulphur River and tributaries under study for the authorized Cooper Lake and Channels project study, there were 58,000 acres of bottomland hardwoods, 12,300 acres of semiwooded, and 18,900 acres of open land habitat in 1974. Prior to man's development of this portion of the Sulphur River watershed, this entire area was bottomland hardwoods. Within the nine county study area, bottomland hardwoods constitute about 17 percent of the total habitat and semiwooded, 30 percent.

In the upstream flood plain of the South Sulphur and Middle Sulphur Rivers where Cooper Lake will be located, native vegetation has been extensively modified. The remaining forest along these rivers provide the last remaining refuges for forest dwelling riparian species. Clearing of the bottomland hardwoods for more intensive land use or loss to inundation by reservoirs is regarded as a major loss of some of the most diverse and productive wildlife habitat in Texas and in the southeastern United States. Though relatively large acreages still exist in some of the major drainages in Texas, it is impossible to predict the preservation of these areas based on past land use and water resource development trends.

Each succeeding loss makes the remainder more valuable. The Reservoir Only plan will result in the direct or indirect loss of 8,969 acres of bottomland hardwoods. This is 15 percent of the remaining bottomland hardwoods in the 30-year Sulphur River flood plain under study. The Reservoir and Levees plan would result in an additional indirect loss of about 6,950 acres, or a total of about 26 percent of the remaining bottomland hardwoods. About 35 percent of the historical bottomland hardwoods have already been cleared in the status quo condition prior to implementation of the Reservoir Only or Reservoir and Levees plans. In addition, Wright Patman Lake inundated a substantial amount of bottomland hardwoods in the lower end of the Sulphur River Basin which are not included in the status quo condition. Based on the above analysis, bottomland hardwoods in the Sulphur River Basin meet criteria for a significant habitat. Therefore, compensation for net adverse bottomland hardwoods losses is a high priority.

Semiwooded habitat, composed of native pasture with scattered woody vegetation, upland woods and several other habitat subcategories, is in short supply in Delta and Hopkins Counties. Within the overall nine county study area, however, and in East Texas in general, semiwooded habitat is not in short supply. The compensation of this habitat type is, therefore, not as high a priority as replacing bottomland hardwoods.

Cost analysis for acquiring the USFWS recommended area and providing initial development, fencing, and annual operation and maintenance to achieve and maintain a 90.0 HUV for all habitats is displayed in Table 8. Cost analysis for the proposed full compensation plan for the Reservoir and Levees plan is displayed in Table 9.

Other Terrestrial Habitat Mitigation Alternatives

There are a number of alternative methods to compensate partially or fully for identified net biological productivity losses. These include restrictive easement acquisition of private lands for fish and wildlife management purposes, intensive development of reservoir perimeter lands acquired for other project purposes (flood pool, fee take line, recreation areas), acquisition of dissimilar habitat types such as open land with conversion to wooded areas, and more intensive initial development of smaller in-kind habitat acreages.

a. Easement acquisition. The primary advantages of this alternative are a lower first cost, low annual O&M, the lands would remain in private ownership, and the lands would still be taxable by local governments. However, experience has shown acquisition costs of such restrictive easements are relatively high and interest less than fee title would not provide as good an assurance that the lands would be managed for the life of the project in the best interest of wildlife to mitigate losses.

b. Intensive development of perimeter project lands. With Cooper Lake, there will be approximately 1,400 acres of bottomland hardwoods,

TABLE 8

COST ANALYSIS - USFWS PROPOSED COMPENSATION PLAN
RESERVOIR ONLY

(1974 Price Levels)

Lands Required

22,700 acres bottomland hardwoods

300 acres semiwooded

4,400 acres open land

6,000 acres upland wooded

Cost	($1,000)
Acquisition	8,509.6
Development	2,088.2
Fencing (67 miles at $10,300/mile)	690.1
Engineering and Design	347.3
Supervision and Administration	296.5
Total First Cost	11,931.7
Interest and Amortization (3-1/4% - 100 years)	404.3
Operation and Maintenance ($3/acre/year)	100.1
Total Average Annual Charges	504.4

TABLE 9

COST ANALYSIS - USFWS PROPOSED COMPENSATION PLAN
RESERVOIR AND LEVEES

(1974 Price Levels)

Lands Required

41,800 acres bottomland hardwoods

400 acres semiwooded

10,600 acres open land

12,700 acres upland wooded

Cost	($1,000)
Acquisition	16,652.3
Development	4,207.6
Fencing (131 miles at $10,300/mile)	1,349.3
Engineering and Design	694.6
Supervision and Administration	511.1
Total First Cost	23,414.9
Interest and Amortization (3-1/4% - 100 years)	793.4
Operation and Maintenance ($3/acre/year)	196.5
Total Average Annual Charges	989.9

530 acres of semiwooded, and 4,550 acres of open habitat in Federal ownership and not designated as recreation areas or needed for project structures. This land could be developed intensively for wildlife habitat management by applying initial development and annual O&M expenditures to raise the value of these areas higher than natural succession. However, regardless of the expenditure on these perimeter lands, net identified productivity losses could not be compensated entirely. Also, there are inherent management and access problems encountered with the narrow band of wildlife management area which would be associated with a reservoir project. There are in addition to perimeter project lands, a 641 acre tract of bottomland hardwoods between the dam and Highway 19/154 which is subject to flooding with the 3,000 cfs floodwater release. This area could also be acquired in easement or fee (under joint acquisition policies of the Secretary of the Army and Secretary of Interior) and used to partially offset losses.

c. Acquisition and conversion of dissimilar habitat types. To regain lost wildlife productivity on bottomland hardwood habitat, it is possible to purchase flood plain cropland or pasture in the vicinity of the reservoir, and convert these lands over time to a wooded flood plain either by natural succession or tree planting. The economic and social impacts of converting productive developed land to a lower economic use are obvious. In addition, a substantial acreage is still required since a long period of time (50 years) is required for the new habitat to reach a high value.

d. Intensive development of smaller in-kind acreages. As displayed in previous sections of this appendix, acreage required to compensate for terrestrial habitat losses varies with the development and management applied. With low development, more land acquisition is required and with high initial development less acreage is required. Fencing costs, tax revenue losses and economic productivity losses, acquisition and administration costs, and O&M costs also vary with the size of the area acquired. The combination of all these factors tends to result in a more cost efficient development and management target to a medium level (90.0 HUV).

Corps Recommended Terrestrial Mitigation Plans

Reservoir Only. The Corps accepts, in part, the recommendation of the USFWS to acquire and manage the White Oak Creek area for compensation of net terrestrial habitat losses due to the Reservoir Only plan. The Corps does not believe acquisition of 33,400 acre full compensation area is justified. The acquisition and management of lands to compensate for bottomland hardwood losses is deemed justified, as this is a recognized significant habitat and is decreasing in quantity. The Corps recommends the acquisition, development, and management of a tract of land within the compensation area recommended by USFWS, which will compensate primarily for bottomland hardwood losses and incidentally will contribute to offsetting net adverse

losses in productivity of semiwooded habitat due to the inclusion of open lands within the acquired area. This tract has been defined by the Corps to consist of about 25,500 acres, including 20,300 acres of bottomland hardwood habitat. The area will be fenced, and initial development will be applied to create a wildlife management area to offset bottomland hardwood losses due to the implementation of the Reservoir Only plan. Operation and maintenance costs will be budgeted to maintain the wildlife management area.

In addition to the above mitigation area, the Corps also recommends the following actions to further compensate for net adverse terrestrial wildlife losses:

a. A 751 acre tract of bottomland wooded habitat between Cooper Dam and Highway 19/154 will be acquired in fee. The majority of this area is flooded with the 3,000 cfs maximum release and a flowage easement is required. The Corps proposes to acquire the land in fee rather than flowage easement so that full public wildlife value can be developed and trail systems can be implemented within the area.

b. During master planning for recreation development and land resource management on lands acquired for Cooper Lake, all perimeter lands not required for project operation or immediate recreation development will be designated for wildlife management purposes or, in the case of recreation land, interim wildlife management. Vegetative plantings and land management practices will be applied to these lands during construction to offset wildlife losses as practicable greater than natural succession processes would.

c. An initial development cost for wildlife habitat development of perimeter lands will be budgeted. Operation and maintenance costs for continued management of these project lands will also be budgeted.

Implementation of the above mitigation plan will mitigate fully for significant habitats (bottomland wooded) adversely impacted by the Reservoir Only plan, and will reduce adverse social and economic impacts of additional land acquisition to a minimum since primarily lands already encumbered by a flowage easement at Wright Patman Lake will be acquired. The recommended mitigation plan will be the more economically efficient by utilizing, in part, land which must be acquired for Cooper Lake anyway.

Table 10 presents cost analysis of the Corps recommended terrestrial habitat mitigation plan for the Reservoir Only plan.

Reservoir and Levees Plan. For the Reservoir and Levees plan, the Corps similarly determined that mitigation for bottomland hardwoods is warranted. This would require the acquisition, development, and management of about 19,100 acres of bottomland hardwoods on easement lands along the Sulphur River upstream of Wright Patman, in addition to the 25,500 acre tract along White Oak Bayou. Incorporating existing open land and semiwooded habitat where unavoidable in land

TABLE 10

COST ANALYSIS - CORPS PROPOSED TERRESTRIAL MITIGATION PLAN
RESERVOIR ONLY

(1974 Price Levels)

Mitigation Area - White Oak Creek	
Lands Acquired	
20,300 acre bottomland hardwood	
5,200 acres open and semiwooded	
Cost	($1,000)
Acquisition	6,045.8
Development	1,261.4
Fencing (60 miles at $10,300/mile)	618.0
Engineering and Design	237.4
Supervision and Administration	175.3
Total	8,337.9
Interest and Amortization (3-1/4% - 100 years)	282.5
Operation and Maintenance ($3/acre/year)	76.6
Subtotal Average Annual Charges	(359.1)
Perimeter Lands - Cooper Lake	
Cost	
Incremental Acquisition Cost (downstream 3,000 cfs release areas) 1/	190.0
Development Costs (revegetation of project lands)	387.5
Subtotal	577.5
Engineering and Design	48.4
Supervision and Administration	33.6
Total First Cost	659.5
Interest and Amortization (3-1/4% - 100 years)	22.3
Operation and Maintenance ($3/acre/year x 7,200 acres)	21.6
Subtotal Average Annual Charges - Project Lands, Mitigation	43.9
TOTAL AVERAGE ANNUAL CHARGES - CORPS TERRESTRIAL MITIGATION PLAN	(403.0)

1/ Cost difference between purchasing flowage easement on 641 acres downstream of dam, and purchase of fee of 751 acres.

acquisition of the additional 19,100 acres of bottomland hardwoods would make the total area acquired about 48,600 acres. The same terrestrial mitigation features for the project lands at Cooper Lake (Reservoir Only plan) would also be appropriate for this plan. Table 11 presents cost data for this mitigation plan.

Water Supply Only Plan. Mitigation for a Water Supply Only plan is largely speculative due to the fact that the plan would be implemented by non-Federal interests. Actual mitigation which would occur with a Water Supply Only project would be contingent upon negotiations between state and Federal fish and wildlife agencies in meeting various permit requirements for project construction. Since the Federal cost of the most probable Water Supply Only project has a direct bearing on benefits claimed in a Federal multiple purpose project, the mitigation deemed justified for a federally implemented Water Supply Only project is considered appropriate. The net adverse impacts of the Water Supply Only plan (Table 7) on bottomland wooded habitat are very similar, but somewhat less than the Reservoir Only plan (19,885 acres compared to 21,424 acres, respectively). A fair estimate of justified mitigation for the Water Supply Only plan is therefore believed to be the acquisition, development, and management of the White Oak mitigation area (25,500 acres) only. There would be no significant amount of perimeter land on a Water Supply Only project to implement additional mitigation measures on project lands and no flowage easement required downstream of the dam. Table 12 presents cost data for this mitigation plan. Table 13 presents a summary comparison of cost data for Supplemental EIS alternatives.

USFWS Aquatic Analysis and Recommendations

By Planning Aid Letter dated August 19, 1980, the USFWS recommended a continuous downstream flow release schedule from Cooper Dam (after normal operating pool is reached) of 45 cfs for the months of September through February, 50 cfs for the months of March through April, and 30 cfs for the months May through August. This schedule was recommended for an average water year, with two contingency plans reducing the recommended downstream releases during drought cycles. The USFWS also evaluated the Corps proposed operating plan which provides for a 5 cfs continuous low flow release when there are no flood pool releases. The release recommendation applies to all three structural alternatives.

The USFWS recommended downstream flow release schedule is based on an optimum relationship between flow and weighted useable stream area for selected key life history stages of 10 indicator species. Conflicts in flow requirements between life stages and species were adjusted through the use of a reduction matrix. This matrix provides a "best" flow which optimizes the total fishery at the damsite by keying on the most critical life stage indicator in any given month. Project losses were determined by totaling the weighted useable area of all segments to be inundated. The USFWS recommended flow schedule is an overall optimum average monthly flow for the remaining river

TABLE 11

COST ANALYSIS - CORPS PROPOSED TERRESTRIAL MITIGATION PLAN
RESERVOIR AND LEVEES

(1974 Price Levels)

<u>Mitigation Area - White Oak Creek and Sulphur River</u>	
<u>Lands Acquired</u>	
39,400 acres bottomland hardwood	
9,200 acres open and semiwooded	
<u>Cost</u>	($1,000)
Acquisition	11,370.0
Development	2,442.8
Fencing	1,174.2
Engineering and Design	452.1
Supervision and Administration	333.6
Total	15,772.7
Interest and Amortization (3-1/4% - 100 years)	534.4
Operation and Maintenance ($3/acre/year)	145.8
Subtotal Average Annual Charges	(680.2)
<u>Perimeter Lands - Cooper Lake</u>	
<u>Cost</u>	
Incremental Acquisition Cost (downstream 3,000 cfs release areas) 1/	190.0
Development Costs (revegetation of project lands)	387.5
Subtotal	577.5
Engineering and Design	48.4
Supervision and Administration	33.6
Total First Cost	659.5
Interest and Amortization (3-1/4% - 100 years)	22.3
Operation and Maintenance ($3/acre/year x 7,200 acres)	21.6
Subtotal Average Annual Charges - Project Lands, Mitigation	43.9
TOTAL AVERAGE ANNUAL CHARGES - CORPS TERRESTRIAL MITIGATION PLAN	(724.1)

1/ Cost difference between purchasing flowage easement on 641 acres downstream of dam, and purchase in fee of 751 acres.

TABLE 12

COST ANALYSIS - CORPS PROPOSED TERRESTRIAL MITIGATION PLAN
WATER SUPPLY ONLY

(1974 Price Levels)

Mitigation Area - White Oak Creek

Lands Acquired

20,300 acre bottomland hardwood

5,200 acres open and semiwooded

Cost	($1,000)
Acquisition	6,045.8
Development	1,261.4
Fencing (60 miles at $10,300/mile)	618.0
Engineering and Design	237.4
Supervision and Administration	175.3
Total	8,337.9
Interest and Amortization (3-1/4% - 100 years)	282.5
Operation and Maintenance ($3/acre/year)	76.6
Total Average Annual Charges	359.1

TABLE 13

ECONOMIC COMPARISON OF CORPS PROPOSED TERRESTRIAL HABITAT MITIGATION PLANS FOR ALTERNATIVE PLANS 1/

(1974 Price Levels)

	Reservoir & Levees ($1000)	Reservoir Only ($1000)	Water Supply Only ($1000)	Non-structural ($1000)
Total Lands - Mitigation Area				
Required (acres)	(48,600)	(25,500)	(25,500)	0 2/
Acquisition Cost	11,370.0	6,045.8	6,045.8	0
Development	2,442.8	1,261.4	1,261.4	0
Fencing	1,174.2	618.0	618.0	0
E&D	452.1	237.4	237.4	0
S&A	333.6	175.3	175.3	0
Subtotal First Cost	15,772.7	8,337.9	8,337.9	0
Interest & Amortization	534.4	282.5	282.5	0
Annual O&M	145.8	76.6	76.6	0
Subtotal Average Annual Charges	(680.2)	(359.1)	(359.1)	0
Perimeter Lands - Cooper Lake				
3,000 cfs Release Area	190.0	190.0		
Development (revegetation)	387.5	387.5		
E&D	48.4	48.4		
S&A	33.6	33.6		
Subtotal First Cost	659.5	659.5		
Interest & Amortization	22.3	22.3		
Annual O&M	21.6	21.6		
Subtotal Average Annual Charges	(43.9)	(43.9)		
TOTAL AVERAGE ANNUAL CHARGES	724.1	403.0	359.1	0

1/ Based on mitigation at a 90.0 HUV level primarily for bottomland hardwoods.

2/ Based on HEP analysis, the implementation of the nonstructural plan would require the acquisition and management of 14,316 acres of semiwooded habitat for full in-kind compensation. However, the majority of the semiwooded habitat losses are the result of conversion of 6,600 acres of this habitat to a more productive bottomland hardwood type. Including costs for in-kind compensation for semiwooded losses is therefore considered inappropriate for this alternative.

segments taking into consideration key life history stages of the 10 indicator species, including weighting where appropriate for desirable species. It does not attempt to increase existing downstream weighted useable area by the amount lost but instead attempts to create an optimum situation for key life history stages. Additionally, in the USFWS analysis, every attempt to compensate for weighted useable area losses for each life history stage with implementation of the recommended flow results in a loss somewhere else in the system. The USFWS then made aquatic stream compensation determinations of various release schedules by relating stream acreage lost to stream acreage gained by increased flow downstream through a relative value factoring system, which essentially assumes a linear relationship between flow increases and biological stream productivity. This relationship is that each acre gained by increasing flow in stream segments below the dam is worth 1.21 acres lost in the reservoir area. Based on these relationships, the USFWS then determined that the present proposed Corps operating plan would result in a 6 percent net loss to stream acreage in the overall project area, and the USFWS recommended schedule would result in a 45 percent gain. A 100 percent gain in adjusted stream acreage is defined as full compensation for net stream losses using these stream acreage/weighted useable area relationships.

Corps Analysis of Aquatic Mitigation Recommendation

The Corps does not accept, in total, the USFWS recommended downstream flow releases. The following analysis presents rationale for the Corps proposed aquatic mitigation plan and reasons for rejection of the USFWS plan.

a. The reduction matrizes used in developing the USFWS recommended flow releases are based on minimizing the percent reduction in the total fishery from a nonexistent optimum condition. While this method may be considered valid for determining an overall "best" average stream ecosystem if flows could be completed controlled, it bears no real relationship to the existing river fishery. Using the reduction matrixes provided by Planning Aid Letter dated August 19, 1980, the South Sulphur River currently existing within the area of the reservoir is greatly reduced from the theoretical optimum during July through November for many species and somewhat reduced from optimum during the remainder of the year, based on median flows in an average water year.

b. The USFWS stream analysis relating acreage lost to acreage gained downstream with increased flows from the reservoir does not give the best indication of stream mitigation achieved by downstream releases. Regardless of ecosystem productivity which may be gained downstream with an optimum flow released from the reservoir, the stream miles and acreage inundated are lost forever. An optimum flow downstream from the reservoir would only compensate for 45 percent of the 106 stream acres lost due to inundation. The Corps 5 cfs release plan would cause a net additional loss of 5 acres in

weighted useable area out of 626 acres downstream of the reservoir, but would not compensate for the 106 acres lost due to inundation based on these acreage relationships. Further, the assumed linear relationship between increased flows and biological productivity basic to this acreage analysis is not borne out for all life stages of all species or even for the key life history stages as evidenced by weighted useable area data presented in supporting data provided in the August 19, 1980, Planning Aid Letter.

c. Biological data presented in supporting data of the August 19, 1980, Planning Aid Letter can be interpreted for impacts to each of the key life history stages of the 10 indicator species used in the USFWS instream flow analysis. While it is recognized that these data are model generated, are indicative only of the species and key life stages considered, and are not directly applicable to overall biological stream productivity, these data are believed by the Corps to be more appropriate in judging mitigative or stream fishery enhancement potential of various Cooper Lake operating plans than the acreage analysis presented by USFWS, and reduction matrixes used for determining optimal flows.

Some generalizations can be made from biological stream data included in the supporting data. If full compensation (total replacement) of identified stream losses caused by the reservoir is defined as 100 percent for any given key life history stage, and 0 percent is defined as no compensation, then any positive percent in the range 0-100 percent in the supporting data represents some level of mitigation flow. Negative percents represent a net loss to the downstream fishery, and percent increases above 100 percent indicate an enhancement flow for the given life history stage.

There were 159 key life history stages evaluated for each downstream flow release schedule presented. The proposed Corps operating release plan of a minimum flow of 5 cfs provides some level of mitigating or enhancement flow downstream for 85 of the 159 life history stages evaluated. In comparison, the USFWS recommended flow provides a mitigating or enhancement flow for 103 of the 159 life history stages. The Corps recommended plan provides a better compensation flow than the USFWS recommended flow in 64 of the 159 life history stages. The Corps recommended flow provides an enhancement situation over and above mitigation in 43 of the 159 life history stages, and the USFWS recommended flow provides enhancement in 70 of the 159 life history stages.

It is recognized that the data provided do not adequately reflect what actually would occur in the downstream reaches since no attempt is made to follow a life cycle of the species throughout the year with a given flow regime or relate species to each other in terms of competition or predator-prey relationships. For example, if spawning is a critical life stage, and spawning life stages for a given species are a negative percent due to a given flow schedule, then it does not matter that the remaining life stages of that species may

be enhanced by the same flow schedule since adequate biological replacement by spawning may not occur. However, it is apparent from the data provided that an increase in downstream flow does not always correlate to an improved ecological fishery, and downstream increased flow releases are not necessarily mitigative for stream losses due to a reservoir.

d. The sport fishery species present in the South Sulphur and Sulphur Rivers, with the possible exception of spotted bass, are commonly found in streams throughout Texas and the southeastern United States, and many are equally suited to lake habitats. It is recognized that the loss of stream habitat due to the project will decrease the net productivity of nonsport stream species which cannot survive in lake habitat. It is also recognized that there is a difference in stream sport fishing versus lake sport fishing even though the species taken may be identical.

Actual sport stream fishing use of the South Sulphur and Sulphur Rivers is severely restricted due to private ownership of flood plain lands, limited public road access, and low flow conditions during summer months. Even though the productivity may exist in these streams to support stream fisherman use, the Corps does not believe that potential is being realized. With construction of Cooper Dam, public access will be provided to remaining natural stream segments in the upper reaches of project lands acquired, to a tailwater fishing facility provided by the Corps below the dam, and to about 4 miles of the South Sulphur River between the outlet channel and Highway 19/154. These are stream fishery potentials made publicly available which, under existing conditions, are largely unutilized in the Sulphur River Basin. In addition, acquisition of the recommended terrestrial habitat mitigation area, if authorized, will provide public access to an additional 14 miles of a much higher quality Sulphur River stream fishery than that being inundated by Cooper Lake, and public access of about 23 miles of stream fishery along White Oak Bayou.

The Corps recognizes that implementation of the Reservoir Only project will cause the loss of a certain amount of productivity of stream species, particularly those not of sport fishing interest. No amount of public access provided will replace biological productivity lost for these nonsport species which do not survive in lake habitats. However, the public access provided will at least partially replace the stream sport fishing opportunity loss, and at the same time will provide a significant new lake fishery. In addition, the 5 cfs low flow release will improve water quality and increase the flow in the river which will enhance adult life stages of most stream species during July through October of the average water year. Median flow without the project in the South Sulphur River segment below the dam for these months is now in the range of 0.1 to 1.1 cfs for these months. In addition, the 5 cfs low flow (median flow) downstream is considered a definite enhancement flow during the one-year-in-ten low flow without project condition in the South Sulphur River, which ranges from 0.0 to 1.8 cfs median flow during all 12 months of the year for this biologically critical period.

e. To be able to meet optimum downstream releases requested by USFWS, there are a limited number of alternative methods hydrologically possible in the planning and design of Cooper Lake if the current status of the project is not considered. The best alternative would be to add storage to the reservoir specifically for making downstream releases. In order to provide a guaranteed downstream release of the magnitude requested by USFWS, about 100,000 acre-feet of storage space would be required in the reservoir between the water supply pool and flood pool. This storage space would cost a minimum of $150,000 in average annual charges, based on an average $44/acre-foot for water supply storage in Cooper Lake. Optimum releases from this additional storage would mitigate potential stream sport fishery losses of about 1,100 man-days of 2,254 man-days lost due to inundation and flow changes, with a net increase in average annual benefits of about $1,650. While this storage could be reduced somewhat through implementing the proposed contingency plans, it would still require a redesign of the dam and lake. The storage for water supply currently designed in the project cannot be used for mitigation storage, nor for multiple instream purposes since contracts for this storage and water supply rights thereof have been executed by the local sponsors. The water supply sponsors have contracts for space between elevation 440 feet msl and 415.5 feet msl which is for water supply. While a certain amount of water would be technically available in the sediment reserve below elevation 415.5 feet msl during early project years, constraints in the wording of the executed contracts makes this storage unusable unless the sponsors were willing to renegotiate the contracts. They are under no obligation to do so. Even if these constraints were not in effect, water supply needs studies conducted by the Corps show a need for the full yield of designed water supply storage in Cooper Lake within 40 years of initial construction. Release of existing water supply storage downstream would therefore be an interim solution and would be contingent on local sponsors making the releases and paying for the water released, or selling interim storage not needed for immediate water supply to either the Corps or a fisheries sponsor in order to make the interim releases. The water supply sponsors have expressed their concern to the Corps (Exhibit 1 of Appendix D) that needs for the full yield will come much earlier.

Multiple use of water supply storage for downstream instream flow purposes was also considered as an alternative. The vast majority of water supply storage in Cooper Lake will be used in the city of Irving and in the North Texas Municipal Water District service area, both out of the Sulphur River Basin and upstream from the dam. Water for these service areas can be taken much more economically from the lake and not from downstream points. Therefore, releases to downstream pick-up points, which could meet part or all of the recommended flows, are not possible for the Cooper Lake project.

A third alternative is to hold a percentage of the flood pool whenever the reservoir is in a flood stage and make releases from this captured flood storage. The Corps conducted studies of this alternative which consider risk involved downstream and ability to meet USFWS

recommended flows initially assuming a 20 cfs yield taken from the water supply storage and ultimately with the full 165 cfs water supply yield committed for out of stream uses. Analyses were made of holding both 5 percent and 10 percent of the total flood pool storage.

Releases of 50 cfs from the 5 percent flood pool were analyzed, resulting in a determination by the Corps that holding flood pool releases was a viable option to partially meeting the USFWS recommended flows downstream. It is recognized, however, that this alternative does not guarantee downstream releases above the 5 cfs minimum currently proposed, but does allow flexibility in operating the flood pool to meet recommended USFWS downstream flows a higher percentage of time than with the current operating plan. Holding the lower 5 percent of the flood pool will amount to holding the lake level about one-third foot above conservation pool (440 msl) while making a 50 cfs release until the lake is again at conservation pool level. Holding the lower 10 percent of the flood pool will amount to holding a lake level about two-thirds of a foot above conservation pool for a short period. The 50 cfs release rate was also analyzed for the 10 percent flood pool.

Based on these routings of Cooper Dam operation, the increase in duration of 50 cfs flows which could be achieved through holding flood waters in the lower 10 percent of the flood pool is not significantly greater in most months than holding only 5 percent of the flood pool. While neither of these conditions is considered a significant impact to recreation or other beneficial aspects of the lake, holding the higher flood pool would involve a slightly higher risk downstream and more shoreline vegetation damage. Based on the period of record routing, risk involved would be greatest in the month of May when potential maximum discharges would increase from 21,100 cfs under normal operation to 28,700 cfs by holding the 5 percent pool and to 31,150 cfs by holding the 10 percent flood pool. During months other than May and after the total 165 cfs water supply yield is being utilized, any increase in risk would be insignificant based on period of record flooding.

Since the percentage gains from holding 5 percent of the flood pool are deemed a significant improvement to meet 50 cfs downstream flows, with only a small percentage increase by holding 10 percent, further studies were only made of making 30 cfs downstream flows from holding the 5 percent flood pool. Figures 7 and 8 display the percentage increases in 50 cfs or greater flow duration which can be obtained by holding the 5 percent flood pool in addition to making a 5 cfs release. A 30 cfs release from captured flood storage would increase flow durations in these figures an additional 1 to 4 percent for each month. This alternative can be implemented at no additional project cost but requires approval of the Texas Department of Water Resources (TDWR). By letter dated January 8, 1981, the TDWR did not object to these releases.

Corps Recommended Aquatic Mitigation Plans

The Corps recommends the following aquatic (stream mitigation features be included in the Reservoir Only and Reservoir and Levees plans:

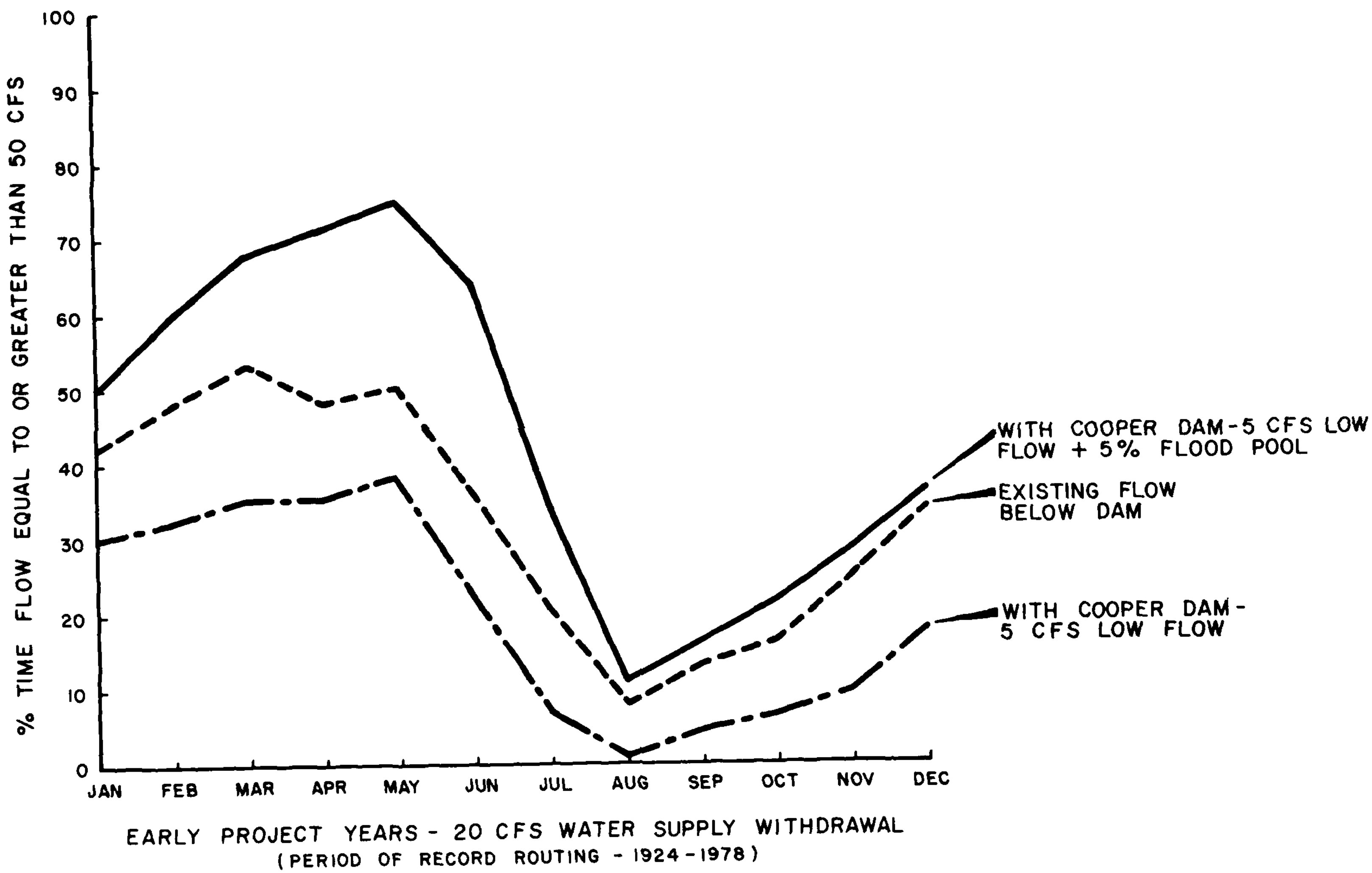
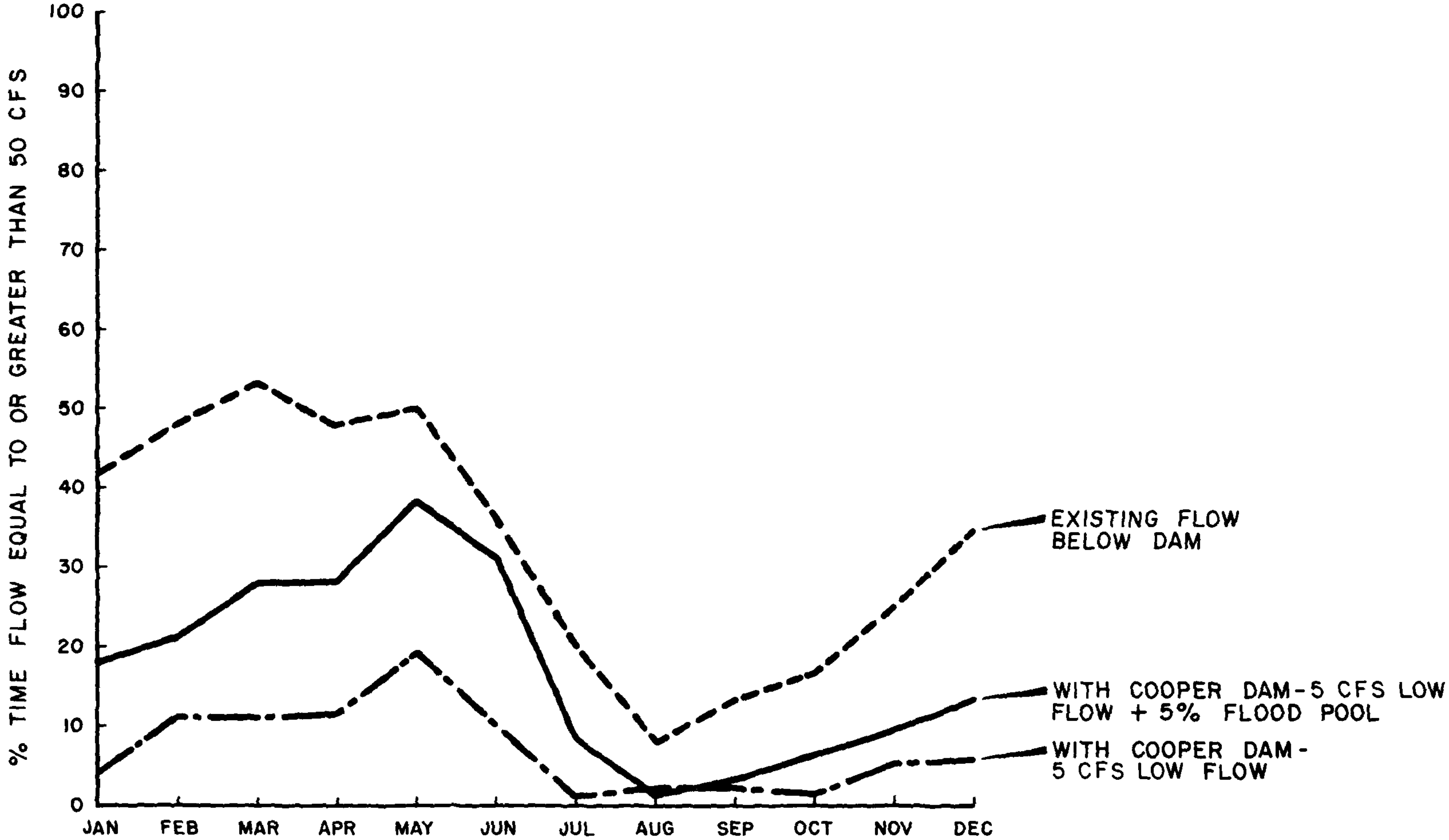


FIGURE 7 - COOPER DAM FLOW DURATION - CASE I



LATER PROJECT YEARS - 165 CFS WATER SUPPLY WITHDRAWAL
(PERIOD OF RECORD ROUTING - 1924 - 1978)

FIGURE 8 - COOPER DAM FLOW DURATION - CASE 2

a. Public access to stream fishery be provided on lands acquired for Cooper Lake, including stream area downstream from the dam to Highway 19/154.

b. Public access to stream fishery be provided on all lands acquired for terrestrial habitat mitigation.

c. The operating plan for Cooper Lake will provide for the retention of the lower 5 percent (1/3 foot) of the flood pool whenever the reservoir is at or above this stage. Higher release rates to preserve the flood control purpose will be maintained above the 5 percent pool, or storage may be evacuated when flood conditions are forecast. Releases will be made from this retained flood storage at the rate recommended by USFWS (45 cfs for September through February, 50 cfs for March and April, 30 cfs for other months) until the lake is again at conservation pool. A 5 cfs constant low flow will be maintained downstream whenever the lake elevation is below 440 msl. These release rates and periods may be modified in the future to optimize beneficial downstream effects, after conducting appropriate hydraulic studies, coordination with the USFWS and TPWD, and when such modifications would not adversely affect the flood control purpose of the project.

For the Water Supply Only plan, the first two recommendations apply. Since there would be no flood pool in a Water Supply Only project, the third recommendation does not apply. The 5 cfs constant low flow would be recommended as a downstream release.

Stage Filling

The USFWS, in the Planning Aid Letter dated August 19, 1980, recommended that the Corps study the feasibility of stage filling for Cooper Lake. Implementation of a stage filling plan has both fishery and wildlife beneficial aspects. Inundation of terrestrial habitat between initial and ultimate reservoir pools is delayed for the length of time that the full pool is not needed for water supply. The lake fishery benefits due to the second inundation of vegetative cover which rejuvenates and expands the fishery sometime during the natural aging process of the reservoir. It also has disadvantages to the fishery, however, in that shoreline habitat and total initial lake fishery potential is much reduced during the initial pool stage.

In the case of Cooper Lake, stage filling is not recommended for a number of reasons.

Contractual agreements for storage of water supply in Cooper Lake have been executed. Based on Corps water supply needs studies, more than half of the storage and subsequent 109 cfs yield of Cooper Lake will be required within 20 years after construction is estimated to be complete. The local sponsors for the water supply storage estimate the full yield will be needed earlier than the Corps estimates. It is likely that a future water supply pool would be required for water

supply 20 years or less from impoundment of the initial pool. Therefore, stage filling would be viable fishery management option for a short span of time over the life of the project. On the other hand, a small initial pool would require the construction of lake recreation and boat ramp facilities in areas which would be lost when the ultimate pool is impounded. The other option to this loss would be to construct initial recreation facilities above the ultimate pool, with the exception of boat ramps, and accept the detrimental aspects of this option of having recreation facilities far from the water during the initial pool operation.

The smaller initial pool would reduce lake fishery potential during the initial stage and reduce lake recreation (boating, skiing) potentials, which would lower overall project economic benefits in these categories.

Providing interim storage space above the initial staged water supply pool for downstream optimum fishery releases would result in an additional lake fluctuation zone, which would also result in adverse impacts on lake esthetics and recreational use during initial pool operation. This would be due primarily to the quantity of storage in a smaller Cooper Lake compared to elevation changes from capturing flood storage. That is, the smaller the storage in relation to flood waters captured, the more difficult it would be to maintain a relatively constant level pool.

Balanced against these adverse effects and failure to develop initially the full potential of the project would be a slight potential gain in a downstream fishery, if temporary flood storage could be held above the interim pool and an extended life for the lake fishery.

Summary of USFWS Recommendations

USFWS COORDINATION ACT REPORT - July 13, 1966.

Previous recommendations by the USFWS, and concurred in by the responsible State agencies, were published in a Coordination Act report for the Cooper Lake and Channels Project dated July 13, 1966. The Corps formally responsded to these recommendations and many were implemented in project planning and design. These recommendations and Corps response were published in the Final EIS filed 24 June 1977. Following are the recommendations, Corps response, and current status.

Comment. The Texas Parks and Wildlife Department be given the opportunity of selecting and administering a suitable tract of project lands for wildlife management.

Response. The Texas Parks and Wildlife Department will be given the opportunity of selecting and administering a suitable track of project land for wildlife management. Within the fee title taking line for the reservoir, approximately 6,000 acres of land, in addition to the 3,300 acres dedicated to general recreation developments, lie outside of the water supply pool. This area, or a portion of it, could be dedicated to fish and wildlife purposes, provided a detailed management plan was submitted to and approved by higher authority.

Current Status. Superseded by current Planning Aid Letter recommendations. Acquisition and management of currently recommended mitigation lands for the Reservoir Only plan are addressed in other sections of this appendix.

Comment. The 1,200 acres of reservoir lands proposed for easement acquisition be acquired in fee title as mitigation for project-induced losses of wildlife habitat.

Response. The 1,200 acres of reservoir lands originally proposed for easement acquisition have already been acquired in fee as part of the project required land purchase. This area is part of the 6,000 acres referred to above.

Current Status. Completed.

Comment. The minimum low-flow release from Cooper Lake during the period June through December be 10 cubic feet per second (c.f.s.), respectively, for the first and second 50 years of project life.

Response. The minimum low flow release from Cooper Lake will be 5 cfs. When water levels exceed the top of the water supply pool (440 msl), a release in excess of 5 cfs can be expected, to a maximum release of 3,000 cfs. The discharges will be in accordance with a schedule based on the ratio of the Cooper Lake flood control pool percent occupied to the Wright Patman Lake flood control pool percent occupied.

Current Status. Superseded by current Planning Aid Letter recommendations. Instream flow recommendations are addressed in other sections of this appendix.

Comment. The project provides for bank fisherman access and needs at the Cooper Dam tail water.

Response. Facilities and access will be provided at the Cooper Dam tail water for bank fishermen.

Current Status. Accepted. These features are included in project design.

Comment. Seining areas be provided in Cooper Lake in accordance with needs and specifications to be established by the Texas Parks and Wildlife Department.

Response. Designation of seining areas was coordinated with the Texas Parks and Wildlife Department. The reservoir clearing plans now provide for clearing, grubbing, and grading of 654 acres within seven seining areas. These areas will be graded with a resultant smooth ground surface with no abrupt projections or depressions. No deviations of more than 1 foot in 10 feet in any direction will be permitted other than the changes in the natural terrain. In connection with clearing operations in the reservoir area, boat passage lanes will be provided to enhance recreational access and marine safety. These boat lanes and seining areas will be appropriately designated by navigation aids and marker buoys. A detailed report on reservoir master plans for recreational development will be prepared in the future. This report will adequately address the physical dimensions and design requirements of these features as well as the feasibility of constructing fishing reefs with cleared timber, old tires, or rock rubble and the feasibility of constructing lighted fishing piers.

Current Status. Accepted. These recommendations are or will be incorporated into design of the reservoir.

Comments. Eight bendways cut off by channel realinement be developed as fishing lakes with provision made for public access to each lake.

Response. With the newly selected plan, channelization, cutoffs, and the associated formation of oxbows will be minimized. Where appropriate, however, earthen plugs will be placed across the old river channel to help confine low river flows to the newly alined channel. These plugs will still allow overtopping during high flows and, accordingly, this should result in the establishment of highly productive oxbow lakes. The possibility of providing access routes to these oxbow lakes was examined; however, the benefits to be derived from these lakes were not sufficient to justify the costs of constructing the access routes.

Current Status. Superseded by selection of the Reservoir Only plan. There will be no additional channelization or formation of oxbows.

Comment. Minimum flows of no less than 100 c.f.s. from Wright Patman Lake be maintained during summer months and, if excess storage is available, higher flows from mid-October through December of each year.

Response. The present rule curve operation at Wright Patman Lake will be maintained. This operational plan provides for a release rate of 96 cfs during the months of May through October when the water supply commitments permit. When lake levels are below elevation 220 msl, releases will equal 10 cfs. When lake levels are above the rule curve, flood releases will be provided on a predetermined schedule up to 10,000 cfs.

Current Status. Not a part of the Cooper Lake Project. The 1966 USFWS report addressed both Wright Patman and Cooper Lake and Channels Project due to the potential for storage reallocation in Wright-Patman with completion of Cooper Lake. The Corps has a continuing program of evaluating instream flow needs and water quality changes below operating reservoirs.

Comment. Initial release of the Wright Patman Lake summer pool be delayed until October 15.

Response. The approved operational plan is intended to assure adequate vector control and to assure adequate flood control storage space prior to the flood season. Those factors preclude the retention of high reservoir levels through the summer months.

Current Status. Not a part of the Cooper Lake Project. Any changes to the approved operational plan for Wright Patman would be based on identified problems and needs for that project and not the Cooper Lake Project.

USFWS RECOMMENDATIONS - September 3, 1976 Report

The following recommendations were made by the USFWS in their restudy of the Cooper Lake and Channels Project, culminating in a letter report dated September 3, 1976. This report was published as Appendix H of the Final EIS filed 24 June 1977, but no Corps response was included.

Comment. An interagency study be initiated to locate the most suitable areas for acquiring the mitigation acreages required to compensate for project wildlife losses.

Response. This study was initiated. The Ecological Planning and Evaluation Procedures used in the 1976 report evolved into the interagency Habitat Evaluation Procedure (HEP) used to evaluate terrestrial habitat losses and compensation requirements for the draft Supplemental EIS. Suitable areas where mitigation can be accomplished have been identified.

Comment. The Corps of Engineers seek congressional authorization for mitigation lands acceptable to the Federal and State fish and wildlife agencies and the Corps of Engineers prior to the continuation of project construction.

Response. Under the Coordination Act, the Corps will include in the project plan "such justifiable means and measures for wildlife purposes as the reporting agency finds should be adopted to obtain maximum overall project benefits." The quantity and location of compensation (mitigation) lands has been determined by the Federal and State fish and wildlife agencies in the current HEP restudy. The Corps recommends in the Supplemental EIS a mitigation plan based on consideration of the results of this interagency restudy. The mitigation plan involves land acquisition and the Corps will seek appropriate congressional authorization for the recommended mitigation plan.

Comment. Mitigation lands be purchased in fee title prior to or concurrent with project completion in order that all lands selected for mitigation purposes be protected from induced clearing.

Response. Current Corps policy is to implement recommended and authorized mitigation measures concurrently with other construction aspects. In the case of Cooper Lake, however, 98 percent of the project lands have already been acquired and purchase of the recommended mitigation lands must be authorized by Congress.

Comment. Development, operation, and maintenance costs of managing mitigation lands be borne by the project.

Response. The Corps is responsible for carrying out authorized mitigation plans. This includes costs of development, operation, and maintenance. These costs are included in the proposed mitigation plan in the Supplemental EIS.

Comment. Water control structures be installed at the juncture of man-made and natural stream channels to divert normal streamflows through natural stream segments.

Response. The plan now recommended includes no new man-made channels.

Comment. Minimum instantaneous downstream releases be at least equal to or exceed the median monthly stream flow of 10 c.f.s., whichever is greater.

Response. This recommendation is superseded by the current aquatic analysis and Planning Aid Letter recommendations.

Comment. A study be initiated to determine the impact and mitigation requirements of Wright Patman Lake enlargement prior to increasing water supply storage.

Response. This will be done in conjunction with feasibility studies on the Wright Patman enlargement.

Comment. Minimum instantaneous downstream releases below Wright Patman Lake be increased to 100 c.f.s. with higher flows from mid-October through December each year.

Response. This is not a part of the Cooper Lake and Channels Project.

SUMMARY OF CURRENT USFWS RECOMMENDATIONS - Planning Aid Letters

The USFWS made the following recommendations through planning aid input into Corps studies leading to recommendation of a plan in the draft Supplement EIS. Corps response to these recommendations is summarized following the recommendation.

Planning Aid Letter, December 9, 1979 (Summarized in Planning Aid Letter Dated 19 August 1980).

Comment ....We recommend that the following considerations be incorporated into the Cooper Lake and Channel Project planning.

Surface water supplies, if developed, be planned to obtain maximum multiple use.

Multiple maximum use includes scheduled releases of water from the Cooper Lake Project, if constructed, and the existing Wright Patman Lake in event storage is reallocated.

Response. Optimum multiple use is, and will continue to be, a factor in the development of Cooper Lake. Storage reallocation or release schedule changes at the existing Wright Patman Lake is beyond the scope of the Cooper Lake Project study, but will be considered in future feasibility studies for storage conversion at Wright Patman Lake, or in conjunction with ongoing water quality studies.

Comment. Storage of these waters for flow release be provided by fine tuning of reservoir storage at the above named projects.

Response. Multiple use of storage provided in Cooper Lake for downstream purposes is not possible. Flood storage capacity in Cooper Lake is designed to provide protection to downstream agricultural lands. Holding of more than a minor portion of this storage to make downstream multiple purpose releases for fish and wildlife increases the risk of flooding to these developed lands. Multiple use of water supply storage in the two reservoirs is also not possible since the water supplies are used by different entities in different locations within the state. The Cooper Lake water supply is used upstream of Cooper Dam.

Comment. During considerations of flow releases to provide for multiple use of the basin surface waters, the outlet works for Wright Patman be studied with a view to providing for outlets at more than

one level. Such outlets should provide water of sufficient quality, for the quantity of water released, to provide enough dissolved oxygen to meet water quality standards.

Response. An investigation of water quality below Wright Patman Dam and effects of structural modification to the outlet works was conducted by the Corps (New Orleans District) culminating in a report dated 16 July 1979. The conclusion reached in that investigation, utilizing a selective withdrawal model (SELECT), was that provision of multiple-level outlet structures would not substantially improve the quality of released water, but would serve to deplete available dissolved oxygen in the reservoir. Dissolved oxygen in released water met all applicable criteria during the years 1975-1977. In 1979, a low runoff year, the lower Sulphur River basin did experience low dissolved oxygen concentations, in both the reservoir and downstream channel areas. The Corps has a continuing program of evaluating water quality within and downstream of operating projects. This recommendation, however, is not applicable to Cooper Lake and Channels Project.

Comment. Selected flood plain lands and adjoining uplands downstream from the proposed Cooper Lake and upstream from Wright Patman Lake be considered as a means to mitigate any terrestrial habitat losses.

Response. These lands were considered in selecting, evaluating, and recommending mitigation plans to compensate for net adverse terrestrial losses. The Corps recommended mitigation plan includes acquisition and management of lands below Cooper Dam and upstream of Wright Patman as requested.

Comment. Natural flood storage areas also be designated wildlife areas in any lands used for nonstructural flood control.

Response. There are no true natural flood storage areas identified in the Sulphur River basin. The existing flood plain does function to spread out and slow overbank discharges. The nonstructural plan evaluated in the Supplemental EIS designates a habitat zone within the 3-year frequency flood plain. This plan is not selected for implementation in the Supplemental EIS.

Comment. Any new or existing levees that may become a part of the Cooper Lake and Channels Project be acquired in public ownership. These lands should be managed for wildlife production and nature trails.

Response. The only levee proposed to be constructed with the Reservoir Only plan now recommended is a spur 4RSS which is needed in conjunction with the outlet channel for Cooper Lake. This spur will continue to provide protection to existing developed land. Approximately 750 acres of land downstream of the dam and upstream of Highway 19/154 are proposed for the purchase as part of the Reservoir Only plan. This land is needed for multiple purposes of flowage regulation at the 3,000 cfs discharge, mitigation of bottomland hardwood terrestrial losses,

and public use. About 3 miles of existing levee adjoin this tract, and a nature trail system is proposed by the Corps along this levee and the new spur 4RSS between the dam and Highway 19/154. Existing levees in the Sulphur River flood plain are owned, operated, and maintained by non-Federal local interests under past agreements, or are privately owned and operated.

Planning Aid Letter Dated 19 August 1980.

Comment. Any levees which are part of the project be managed for wildlife diversity.

Response. See response above. Spur 4RSS and levee 4RSS to Highway 19/154 will be publically accessible. The levee, however, must be maintained in a condition which primarily will fulfill its flood control purpose. Within the levees adjacent to the river, and interior drainage facilities and borrow areas will be managed for their wildlife value.

Comment. Any levees which are part of the project be designated for public use nature trails.

Response. See response above. Levee 4RSS will be publically accessible and trail access will be provided.

Comment. Any lands designated for nonstructural flood control be designated as wildlife lands. Such land should be acquired in public ownership.

Response. See response above. There are no lands acquired for nonstructural flood control with the Reservoir Only plan.

Comment. To compensate for terrestrial wildlife losses resulting from implementation of the Cooper Lake with Flood Control, No New Channels or Levees (Reservoir Only) about 22,700 acres of bottomland hardwoods, 4,400 acres of open-land, 300 acres of semi-wooded and 6,000 acres of upland woods, as shown on a map which has been provided to your planners, be acquired and managed to a Habitat Unit Value of nine at an estimated O&M cost of five dollars per acre (1980 costs).

Response. The Corps accepts compensation recommendations for bottomland hardwood habitat losses. The Corps recommends acquisition, development and management of about 25,500 acres within the area generally as proposed by USFWS. The Corps also recommends terrestrial habitat mitigation features on project lands at Cooper Lake, and lands downstream of Cooper Dam.

Comment. That compensation lands include those adjoining the upper end of Wright Patman Lake and extend upstream in the White Oak Creek drainage.

Response. The Corps recommended mitigation plan includes mostly these lands.

Comment. Study the feasibility of stage filling. If the study results are positive, and the time and elevation differences between Stage I and Stage II are acceptable for propagation of fish and wildlife, then we recommend stage filling.

Response. The Corps does not accept stage filling recommendations for Cooper Lake. Corps feasibility analysis of stage filling potential at Cooper Lake resulted in a determination that short term benefits of stage filling were not as important as developing the full potential of the lake initially.

Comment. Include in the operations manual, the following release schedules which are designed to mitigate unavoidable stream losses attributable to the creation of Cooper Lake.

a. Upon completion of the impoundment structure, a continuous release of 5 cfs should be implemented until normal operating level is reached or if stage filling is shown to be feasible, then until Stage I is reached.

b. Once the normal operating level or Stage I is reached, a continuous release schedule of (1) 45 cfs for months of September through February, (2) 5 cfs for the months of March and April, and (3) 30 cfs for the months May through August should be implemented.

c. During a mild drought period (ex. one in four year low flow), the above recommendation (7b) should be reduced by 10 cfs.

d. During a more severe drought period (ex. one in seven year low flow) the recommendation should be reduced to (1) 25 cfs for the months September through January, (2) 35 cfs for the months February and March, (3) 25 cfs for April, (4) 20 cfs for May, (4) 15 cfs for June, and (5) 10 cfs for the months July and August.

e. During an even more severe drought period (ex. one in ten year low flow), the recommendation should be reduced to a continuous release of 5 cfs for all months.

Response.

a. Accepted. This recommendation will be included in the deliber ate impoundment plan.

b. Rejected. The Corps cannot make a continuous release as requested. The Corps will include in the Operating Plan a procedure for holding 5 percent of the flood pool, and making releases at the rate requested for each month when this storage is available. A 5 cfs continued low flow release will be made.

c., d., and e. These releases could also be made, as requested, part of the time through use of retained flood pool storage. However, droughts cannot be predicted and the contingency plans would have to be based on lake levels. Since the Corps plan only utilizes captured flood storage, drought contingency plans are a moot point since elevations of the lake direct the implementation of the USFWS recommended flow when possible.

Comment. List and analyze the techniques available for predicting droughts and relate these findings to the implementation of the above drought contingency plans.

Response. There are no techniques for predicting long term droughts. The maximum rainfall forecast currently used by the National Weather Service is about 3 months, though studies are currently being done to extend forecasts to 1 year. Drought years in North Central Texas and East Texas have occurred on an average frequency of once every 7 years, and two consecutive drought years have occurred on the average of one very 15-20 years. There is, however, no proven way to predict droughts, or to determine if a current drought will continue into the future. The only way to develop contingency plans for downstream releases is to utilize reservoir levels. Since water supply storage is not available for making downstream releases, lake elevations in the flood pool are the only means available for developing contingency plans for Cooper Lake.

Section 2(b) USFWS Coordination Act Report (February 9, 1981).

Recommendation #1. The Corps of Engineers adopt and implement the following release schedules for Cooper Lake:

a. Upon completion of the impoundment structure, a continuous release of 5 cfs be implemented until normal operating level is reached or until stage 1 is reached.

b. Once the normal operating level or stage 1 is reached, a continuous release schedule of (1) 45 cfs for months September through February, (2) 50 cfs for the months March and April, and (3) 30 cfs for the months of May through August be implemented.

c. During a mild drought period (example, one in four years low flow), the above recommendation (b(1)) be reduced by 10 cfs.

d. During a more significant drought (example, one in seven years low flow), the recommendation be reduced to (1) 25 cfs for the months of September through January, (2) 35 cfs for the months February and March, (3) 25 cfs for April, (4) 20 cfs for May, (5) 14 cfs for June, and (6) 10 cfs for the months July and August.

e. During an even more severe drought period (example, one in 10 years low flow), the recommendation should be reduced to a continuous release of 5 cfs for all months.

Corps Response.

a. Accepted. This recommendation will be included in the deliberate impoundment plan.

b. Rejected. The Corps cannot make a continuous release as requested. The Corps will include in the Operating Plan a procedure for holding 5 percent of the flood pool and making releases at the rate requested for each month when this storage is available. The Corps retains the right to maintain higher release rates when pool stages higher than the 5 percent flood pool are forecast, or when flood control purposes may be jeopardized due to flood conditions. Monthly release rates and periods may be modified in the future to optimize beneficial downstream effects, only after appropriate hydraulic studies, coordination with USFWS and TPWD, and when such changes would not adversely affect the flood control purpose. A 5 cfs continued low flow release will be made when lake elevations are below 440 feet msl.

c., d., and e. These releases could also be made, as requested, part of the time through use of retained flood pool storage. However, droughts cannot be predicted, and the contingency plans would have to be based on lake levels. Since the Corps plan only utilizes captured flood storage, drought contingency plans are a moot point since elevations of the lake direct the implementation of the USFWS recommended flow when possible.

Recommendation 2. Cooper Lake be impounded in two phases to complement the water supply/demand analysis.

Corps Response. The Corps does not accept stage filling recommendations for Cooper Lake. Corps feasibility analysis of stage filling potential at Cooper Lake resulted in a determination that short-term benefits of stage filling were not as important as developing the full potential of the lake initially.

Corps water supply needs studies indicate a need for more than half the yield in less than 20 years. The NTMWD has provided data indicating greater needs, much earlier (exhibit 1 of appendix D), and has expressed concern over planning for average, or historic conditions, rather than system stress. However, to determine economic feasibility of stage filling, it was assumed that an initial project would be designed to accommodate the Corps identified water supply needs through the year 2010 (about 60 mgd). This resulted in a Stage I water supply pool elevation (including sediment reserve for ultimate conditions) of 427 feet msl and a surface area of about 10,250 acres. All lands would be acquired initially for the full size project. The embankment would be slightly redesigned to accommodate the lower normal pool level, with gates, spillway, and other major features designed to accommodate the ultimate

pool level of 440 feet msl, while still functioning properly under stage I conditions. Additional fill on the embankment and necessary modification to the gated spillway would be deferred until stage II, as would some road work, clearing, and relocation of boat ramps. Recreation facilities would be constructed above the ultimate pool so they would not require relocation. The direct construction cost differential in a staged and unstaged Cooper Lake, at March 1980 price levels, is estimated below:

Item	Unstaged Project	Staged Project		
		Stage I	Stage II	Total
	($1,000)	($1,000)	($1,000)	($1,000)
Lands	19,904	19,904	0	19,904
Relocations	3,778	3,778	0	3,778
Reservoir (Incl. clearing)	4,825	3,575	2,356	5,931
Dam	48,371	43,186	6,181	49,367
Roads	3,305	3,305	235	3,540
Recreation	6,440	6,440	0	6,440
Buildings, Grounds, Utilities	792	792	0	792
Permanent Operating Equipment	472	472	0	472
Levees	380	380	0	380
Subtotal	88,267	81,832	8,772	90,604

At March 1980 price levels, a stage I Cooper Lake providing about 60 mgd dependable yield would have a direct construction cost of $81,832,000. This compares to $88,267,000 for the unstaged reservoir recommended in the supplemental EIS. For the second stage of construction, an additional $8,772,000 in construction costs would be incurred, primarily for stripping and additional fill on the embankment, road work, and clearing additional areas within the stage II pool. While the total March 1980 costs for a staged project are only $2,400,000 more in direct construction costs, this does not take into account 20 years of inflation on the estimated $8,772,000 in stage II construction costs. The benefits to be obtained from a staged project are a temporary postponement in wildlife habitat inundation (which has been almost fully mitigated with the proposed plan), and a rejuvenation of the reservoir fishery after a period of natural aging. The average annual fishery man-day gains for a stage-filled project are 214,344, compared to 192,202 for the proposed project, based on USFWS data. This would increase average annual benefits by about $33,200 or less than 0.5 percent of the total benefits at 1980 price levels.

In addition to the increased costs for a small increase in fishery benefits, there are other considerations for not recommending a staged project. Recreation facilities constructed above the ultimate pool in a staged project would be more distant from the water resource, with their use attractiveness lessened. Relocation of boat ramps or other facilities would be an expense chargeable to the water supply sponsors, for which they receive no benefits.

As for lake fluctuations, some flood water storage would occur almost annually in the Sulphur River Basin. Based on area-capacity data for Cooper Lake, a first stage project at conservation pool (427 feet msl) capturing 10,500 acre-feet of flood storage would have a pool rise of 1 foot. The project at the proposed 440 feet msl pool would have a less than 0.5 foot pool rise with the same storage. The full size project can capture 104,000 acre-feet of flood storage with a 5 foot rise into the flood pool. A staged project capturing the same quantity of flood storage would have a pool rise greater than 8 feet. In addition, water supply withdrawals or interim downstream releases from an initial stage project would cumulatively add to fluctuations of lake levels more than with the full size project. Lake fluctuation as a fishery management tool is only beneficial if the timing of drawdowns can be completely controlled, which is not the case in a multiple purpose project.

Recommendation 3. That the Corps of Engineers proceed with the terrestrial habitat mitigation plan as presented in the draft supplemental EIS.

Corps Response. Accepted.

Recommendation 4. That the terrestrial mitigation plan presented in the supplemental EIS be implemented concurrent with project construction.

Corps Response. The Corps will not initiate physical construction until Congress has acted on the recommended mitigation plan. Development of the mitigation area and completion of the project will be as concurrent as practical considering the status of the project and budgetary requirements.

Recommendation 5. That when the terrestrial mitigation area has been acquired in fee simple title, fenced, and initial plantings of selected flora completed by the Corps of Engineers, the area be transferred to the TPWD for administration under conditions of a General Plan in accordance with the provisions of and under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended: 16 U.S.C. et seq.).

Corps Response. Accepted. Initial development of the area will be accomplished by the Corps, and the TPWD will be offered management of the lands.

Recommendation 6. That the USFWS be provided an opportunity to participate in the preparation of the master plan for the Cooper Lake project.

Corps Response. Accepted. The USFWS will be provided full opportunity to have input into the master plan for Cooper Lake.

APPENDIX B

EXHIBIT 1

SUPPLEMENTAL INSTREAM FLOWS/AQUATIC MITIGATION ANALYSIS

TABLE OF CONTENTS

TABLES

Supplemental Analysis of Instream Flows/Aquatic
Mitigation Considerations

Purpose. The purpose of this analysis is to present additional data regarding instream flows and aquatic mitigation, which has surfaced as a controversial issue in coordination of the draft supplemental EIS for the Cooper Lake and Channels Project. Comments relating to the instream flow/aquatic mitigation issue were received from the US Department of Interior, Texas Parks and Wildlife Department, Texas Department of Water Resources, Sierra Club, Texas Committee on Natural Resources, Sportmen's Clubs of Texas, and the Wildlife Management Institute. These comments and Corps response are published in Section VI of the final supplemental EIS.

This analysis has not changed the basic recommendation of the Corps to maintain the 5 cfs minimum low flow release plan, supplemented by releases from the lower 5 percent (one-third foot) of flood pool storage when the lake is above elevation 440.0 feet msl. The Corps interpretation of what would constitute appropriate mitigation flows, if implemented on a continuous release schedule, is presented here. The implementation of a mitigation flow, however, and the allocation of water use within Federal projects, remains a State authority.

Background. By Planning Aid Letter dated August 19, 1980, and in a current Section 2(b) Coordination Act Report, the USFWS recommended a continuous downstream flow release schedule from Cooper Dam (after normal operating pool is reached) of 45 cfs for the months of September through February, 50 cfs for the months of March through April, and 30 cfs for the months May through August. This schedule was recommended for an average water year, with two contingency plans reducing the recommended downstream releases during drought cycles. The USFWS also evaluated the Corps proposed (Final EIS) operating plan which provides for a 5 cfs continuous low flow release when there are no flood pool releases. The USFWS release recommendation applies to all three structural alternatives.

The USFWS recommended downstream flow release schedule is based on an optimum relationship between flow and weighted useable stream area by month for one selected life history stage of one species of 10 indicator species. Conflicts in flow requirements between life stages and species were adjusted through the use of a reduction matrix. This matrix provides a "best" flow which optimizes flow at the damsite for the most affected or "limiting" life stage indicator in any given month. Conversely, project losses were determined by totaling the weighted useable area for all life stages of all 10 indicator species of all segments to be inundated. The USFWS recommended flow schedule is an overall optimum average monthly flow for the remaining downstream river segments taking into consideration one life history stage for one species for each month. The optimum flow includes weighting where FWS deemed appropriate for "desirable" species. It does not attempt to adjust existing downstream weighted useable area for all species by the amount

lost or gained, but instead attempts to create an optimum situation by month for a limiting life history stage.

Additionally, when an attempt was made by the USFWS to analyze compensation of the optimum and contingency flows in terms of habitat units replaced, the reduction matrix method again falls short. When compensation is achieved for the "limiting" species that were identified through the reduction matrix, losses occur to other species with no logical relationship to ecosystem functions. Because of this problem, the USFWS applied another method of determining compensation potential of the optimum and contingency flows. Habitat units per unit area were determined for the total upstream and total downstream segments and then compared to show that, at median flow, habitat value of the downstream segments is 1.21 times greater per unit area than the upstream segments. Based on this relationship and assuming median flow to be the existing baseline condition, an analysis of wetted surface area was made. This analysis also assumes a linear relationship between flows and habitat units for all life stages of all species that is not supported by their habitat unit or weighted useable area data. In any event, the acreage analysis performed indicates that the Corps 5 cfs minimum low flow release plan would result in a 6 percent loss of downstream habitat (surface area) in terms of acreage wetted by median flow, in addition to habitat inundated by the lake. The optimum flow would result in a 48 acre increase in downstream area. It was then determined by USFWS that the increase in area would represent 45 percent compensation for stream losses due to inundation. The Fort Worth District does not accept this compensation analysis but does acknowledge a state-of-the-art validity of the habitat unit data generated by the Physical Habitat Simulation Model (PHABSIM). The following paragraphs present a Corps analysis of the habitat unit data generated by the model.

Species Selection. In supporting data to the Planning Aid Letter dated August 19, 1980, the USFWS, Fort Worth Office of Ecological Services used a list of selected fish species which met two criteria as indicators for aquatic habitat evaluations. First, the species selected were listed as having been determined to actually occur in the stream segments of the project area by various sampling methods through the study period. The second criterion for species selection was that current life history/probability-of-use information be available in the directory compiled by the Instream Flow Service Group in Fort Collins, Colorado. The list of species meeting both these criteria included gizzard shad, carp, channel catfish, white bass, spotted bass, largemouth bass, green sunfish, bluegill, white crappie, and freshwater drum. Life history information for these species was obtained from library tape files in Fort Collins which were the result of a national study to determine preference of fish for basic hydraulic parameters such as depth and velocity. It is noted by the USFWS that the species selected for evaluation are merely indicators chosen to quantify the stream habitat and that, ideally, only typical stream species (selected shiners and darters) should be used for stream evaluations. Considering the lack of immediately available life history information for those species which are truely representative of the stream ecosystem, the USFWS's selection of more ubiquitous species was considered acceptable by the Corps.

Since species may be selected as indicators of relative productivity of an ecosystem at varying flows on an annual basis, it appears reasonable that indicator species, or life stages, could also be selected on a monthly basis. Based on this assumption, the Fort Worth District selected one group of indicator species life stages for each month. Selected indicator species life stages are presented in Table 1 and are taken directly from the critical life history stage information provided as supporting data to the August 19, 1980, Planning Aid Letter from the USFWS.

Relative Value Indices. In making decisions, such as alteration of streamflows, which would alter habitat conditions and therefore affect all species (i.e. result in gains or losses to different life stages of different species), trade-offs must be made between species to reflect their perceived importance. In the Corps analysis, because most species selected as indicators will do well and even prefer lake environments or large slow streams, the Fish and Wildlife Service's weighting for species importance to man was determined to be inappropriate. The primary objective of this compensation analysis is to determine habitat conditions favorable to stream species which do not do well in lakes and which would suffer habitat losses due to inundation of stream segments by the proposed Cooper Lake.

Although USFWS's weighting for perceived importance to man was determined to be inappropriate, weighting for various factors influencing species interrelationships within the stream ecosystem is necessary to account for the relative importance between species life stages. Biological and ecological functions which are considered critical to the success of the ecosystem include fecundity of the species, vulnerability of the species to predation, competition between species for food, cover, and space, and recruitment to reestablish species populations. Table 2 is a pairwise comparison matrix of these functions which are used in the Corps Habitat Evaluation as ranking criteria in establishing Relative Value Indices (RVI's) for each species. This matrix was developed according to the procedures outlined in Habitat Evaluation Procedures (HEP), Ecological Services Manual (ESM) 102 of the USFWS published in 1980.

With the selection of indicator species by month, RVI's were determined for each indicator species life stage by month. Tables 3-12 present species ratings for the four ranking criteria as well as the overall RVI for each species. It should be noted that the months of January and February and the months of November and December had the same groups of species life stages identified as critical and subsequently those pairs of months have been combined in the tables.

Habitat Evaluation. The basis of the Corps' habitat evaluation are the habitat unit data provided by the 19 August 1980 Planning Aid Letter of the USFWS. Study sites were selected by the USFWS and concurred in by the Fort Worth District in April, 1980. The Service's Physical Habitat Simulation Model (PHABSIM) also referred to as the "Incremental Method"

TABLE 1 SELECTED MONTHLY INDICATOR SPECIES/LIFE HISTORY STAGE

SPECIES	LIFE HISTORY STAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Gizzard shad	Spawning			X	X								
	Fry				X	X							
	Juvenile					X	X	X	X	X	X	X	X
	Adult	X	X								X	X	X
Carp	Spawning			X	X								
	Fry				X	X							
	Juvenile					X	X	X	X	X			
	Adult	X	X						X	X	X	X	X
Channel catfish	Spawning					X	X						
	Fry						X	X					
	Juvenile							X	X	X	X		
	Adult	X	X	X	X					X	X	X	X
White bass	Spawning			X	X								
	Fry				X	X							
	Juvenile					X	X	X	X	X	X		
	Adult	X	X							X	X	X	X
Spotted bass	Spawning				X	X							
	Fry					X	X						
	Juvenile						X	X	X	X	X		
	Adult	X	X	X						X	X	X	X
Largemouth bass	Spawning			X	X								
	Fry				X	X							
	Juvenile					X	X	X	X	X			
	Adult	X	X						X	X	X	X	X
Green sunfish	Spawning					X	X						
	Fry						X	X					
	Juvenile							X	X	X	X		
	Adult	X	X	X	X					X	X	X	X
Bluegill	Spawning					X	X						
	Fry						X	X					
	Juvenile							X	X	X	X		
	Adult	X	X	X	X					X	X	X	X
White crappie	Spawning				X	X							
	Fry					X	X						
	Juvenile						X	X	X	X	X		
	Adult	X	X	X						X	X	X	X
Freshwater drum	Spawning				X	X							
	Fry					X	X						
	Juvenile						X	X	X	X	X		
	Adult	X	X	X						X	X	X	X

TABLE 2 PAIRWISE COMPARISON MATRIX

RANKING CRITERIA	RANKING CRITERIA					TOTAL	RELATIVE WEIGHT
	(1)	(2)	(3)	(4)	(5)		
(1) FECUNDITY	N/A[1]	1	.5	1	1	3.5	.35
(2) PREDATION VULNERABILITY	0	N/A	1	0	1	2	.2
(3) COMPETITION	.5	0	N/A	1	1	2.5	.25
(4) RECRUITMENT	0	1	0	N/A	1	2	.2
(5) DUMMY	0	0	0	0	N/A	0	0
						10	1.0

[1] N/A - NOT APPLICABLE

TABLE 3

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH January and February

EVALUATION SPECIES (LIFE STAGE)	CRITERIA (1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2	RELATIVE VALUE	RELATIVE VALUE INDEX
Gizzard Shad (Adult)	0 0	0.1 .02	0.1 .025	0.2 .04	.085	.32
Carp (Adult)	0 0	0 0	0.1 .025	0.1 .02	.045	.17
Channel Cat-fish (Adult)	0 0	0 0	0.2 .05	0.2 .04	.09	.34
White Bass (Adult)	0 0	0.1 .02	0.1 .025	0.5 .10	.145	.55
Spotted Bass (Adult)	0 0	0.1 .02	0.6 .15	0.1 .02	.19	.72
Largemouth Bass (Adult)	0 0	0.1 .02	0.5 .125	0.1 .02	.165	.62
Green Sun-fish (Adult)	0 0	0.5 .10	0.5 .125	0.2 .04	.265	1.00
Bluegill (Adult)	0 0	0.6 .12	0.2 .05	0.2 .04	.21	.79
White Crappie (Adult)	0 0	0.1 .02	0.3 .075	0.2 .04	.135	.51
Freshwater Drum (Adult)	0 0	0 0	0.2 .05	0.1 .02	.07	.26

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

TABLE 4

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH March

EVALUATION SPECIES (LIFE STAGE)	CRITERIA (1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2	RELATIVE VALUE	RELATIVE VALUE INDEX
Gizzard Shad (Spawn)	0.8 .28	0.1 .02	0.1 .025	0.2 .04	.365	.65
Carp (Spawn)	0.8 .28	0 0	0.1 .025	0.1 .02	.325	.58
Channel Cat-fish (Adult)	0 0	0 0	0.2 .05	0.2 .04	.09	.16
White Bass (Spawn)	0.8 .28	0.1 .02	0.1 .025	0.8 .16	.485	.86
Spotted Bass (Adult)	0 0	0.1 .02	0.4 .10	0.1 .02	.14	.25
Largemouth Bass (Spawn)	0.8 .28	0.1 .02	0.8 .20	0.3 .06	.56	1.00
Green Sun-fish (Adult)	0 0	0.5 .10	0.5 .125	0.2 .04	.265	.47
Bluegill (Adult)	0 0	0.6 .12	0.2 .05	0.2 .04	.21	.38
White Crappie (Adult)	0 0	0.1 .02	0.3 .075	0.2 .04	.135	.24
Freshwater Drum (Adult)	0 0	0 0	0.2 .05	0.1 .02	.07	.12

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

TABLE 5

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH April

EVALUATION SPECIES (LIFE STAGE)	CRITERIA (1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2	RELATIVE VALUE	RELATIVE VALUE INDEX
Gizzard Shad (Spawn)	0.8 .28	0.1 .02	0.1 .025	0.2 .04	.365	.65
Gizzard Shad (Fry)	0 0	0.6 .12	0.2 .05	0 0	.17	.30
Carp (Spawn)	0.8 .28	0 0	0.1 .025	0.1 .02	.325	.58
Carp (Fry)	0 0	0.7 .14	0.3 .075	0 0	.215	.38
Channel Cat-fish (Adult)	0 0	0 0	0.2 .05	0.2 .04	.09	.16
White Bass (Spawn)	0.8 .28	0.1 .02	0.1 .025	0.8 .16	.485	.87
White Bass (Fry)	0 0	0.7 .14	0.3 .075	0 0	.215	.38
Spotted Bass (Spawn)	0.8 .28	0.1 .02	0.5 .15	0.2 .04	.49	.88
Largemouth Bass (Spawn)	0.8 .28	0.1 .02	0.8 .20	0.3 .06	.56	1.00
Largemouth Bass (Fry)	0 0	0.5 .10	0.5 .125	0 0	.225	.40
Green Sun-fish (Adult)	0 0	0.5 .10	0.5 .125	0.2 .04	.265	.47
Bluegill (Adult)	0 0	0.6 .12	0.2 .05	0.2 .04	.21	.38
White Crappie (Spawn)	0.8 .28	0.1 .02	0.5 .125	0.3 .06	.485	.87
Freshwater Drum (Spawn)	0.8 .28	0 0	0.2 .05	0.1 .02	.350	.62

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

TABLE 6

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH May

EVALUATION SPECIES (LIFE STAGE)	CRITERIA (1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2	RELATIVE VALUE	RELATIVE VALUE INDEX
Gizzard Shad (Fry)	0 / 0	0.6 / .12	0.2 / .05	0 / 0	.17	.30
Gizzard Shad (Juve)	0 / 0	0.8 / .16	0.1 / .025	0.1 / .02	.205	.37
Carp (Fry)	0 / 0	0.7 / .14	0.3 / .075	0 / 0	.215	.39
Carp (Juve)	0 / 0	0.7 / .14	0.1 / .025	0 / 0	.165	.30
Channel Cat-fish (Spawn)	0.8 / .28	0 / 0	0.3 / .075	0 / 0	.355	.64
White Bass (Fry)	0 / 0	0.7 / .14	0.3 / .075	0 / 0	.215	.39
White Bass (Juve)	0 / 0	0.7 / .14	0.5 / .125	0 / 0	.265	.48
Spotted Bass (Fry)	0 / 0	0.5 / .10	0.3 / .075	0 / 0	.175	.32
Spotted Bass (Spawn)	0.8 / .28	0.1 / .02	0.6 / .15	0.2 / .04	.49	.89
Largemouth Bass (Fry)	0 / 0	0.5 / .10	0.5 / .125	0 / 0	.225	.41
Largemouth Bass (Juve)	0 / 0	0.5 / .10	0.8 / .20	0 / 0	.30	.55
Green Sun-fish (Spawn)	0.8 / .28	0.4 / .08	0.6 / .15	0.2 / .04	.55	1.00
Bluegill (Spawn)	0.8 / .28	0.5 / .10	0.3 / .075	0.2 / .04	.495	.90
White Crappie (Fry)	0 / 0	0.5 / .10	0.4 / .10	0.3 / .06	.26	.47
White Crappie (Spawn)	0.8 / .28	0.1 / .02	0.5 / .125	0.3 / .06	.485	.88
Freshwater Drum (Spawn)	0.8 / .28	0 / 0	0.2 / .05	0.1 / .02	.350	.64

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

TABLE 7

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH June

EVALUATION SPECIES (LIFE STAGE)	CRITERIA				RELATIVE VALUE	RELATIVE VALUE INDEX
	(1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2		
Gizzard Shad (Juve)	0 / 0	0.8 / .16	0.1 / .025	0.1 / .02	.205	.37
Carp (Juve)	0 / 0	0.7 / .14	0.1 / .025	0 / 0	.165	.30
Channel Catfish (Fry)	0 / 0	0.6 / .12	0.7 / .175	0 / 0	.295	.54
Channel Catfish (Spawn)	0.8 / .28	0 / 0	0.3 / .075	0 / 0	.355	.64
White Bass (Juve)	0 / 0	0.7 / .14	0.5 / .125	0 / 0	.265	.48
Spotted Bass (Fry)	0 / 0	0.5 / .10	0.3 / .075	0 / 0	.175	.32
Spotted Bass (Juve)	0 / 0	0.6 / .12	0.8 / .20	0 / 0	.32	.58
Largemouth Bass (Juve)	0 / 0	0.5 / .10	0.8 / .20	0 / 0	.30	.55
Green Sunfish (Fry)	0 / 0	0.6 / .12	0.3 / .075	0 / 0	.195	.35
Green Sunfish (Spawn)	0.8 / .28	0.4 / .08	0.6 / .15	0.2 / .04	.55	1.00
Bluegill (Fry)	0 / 0	0.4 / .08	0.3 / .075	0 / 0	.155	.28
Bluegill (Spawn)	0.8 / .28	0.5 / .10	0.3 / .075	0.2 / .04	.495	.90
White Crappie (Fry)	0 / 0	0.5 / .10	0.4 / .10	0.3 / .06	.26	.47
White Crappie (Juve)	0 / 0	0.6 / .12	0.7 / .175	0 / 0	.295	.54
Freshwater Drum (Juve)	0 / 0	0.5 / .10	0.3 / .075	0 / 0	.175	.32

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

TABLE 8

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH July

EVALUATION SPECIES (LIFE STAGE)	CRITERIA (1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2	RELATIVE VALUE	RELATIVE VALUE INDEX
Gizzard Shad (Juve)	0 0	0.8 .16	0.1 .025	0.1 .02	.205	.64
Carp (Juve)	0 0	0.7 .14	0.1 .025	0 0	.165	.52
Channel Cat-fish (Fry)	0 0	0.6 .12	0.7 .175	0 0	.295	.92
Channel Cat-fish (Juve)	0 0	0.6 .12	0.8 .20	0 0	.32	1.00
White Bass (Juve)	0 0	0.7 .14	0.5 .125	0 0	.165	.52
Spotted Bass (Juve)	0 0	0.6 .12	0.8 .20	0 0	.32	1.00
Largemouth Bass (Juve)	0 0	0.5 .10	0.8 .20	0 0	.30	.94
Green Sun-fish (Fry)	0 0	0.6 .12	0.3 .075	0 0	.195	.61
Green Sun-fish (Juve)	0 0	0.5 .10	0.3 .075	0 0	.175	.55
Bluegill (Fry)	0 0	0.7 .14	0.3 .075	0 0	.215	.67
Bluegill (Juve)	0 0	0.6 .12	0.2 .05	0 0	.17	.53
White Crappie (Juve)	0 0	0.6 .12	0.7 .175	0 0	.295	.92
Freshwater Drum (Juve)	0 0	0.5 .10	0.3 .075	0 0	.175	.55

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

TABLE 9

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH August

EVALUATION SPECIES (LIFE STAGE)	CRITERIA (1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2	RELATIVE VALUE	RELATIVE VALUE INDEX
Gizzard Shad (Juve)	0 0	0.8 .16	0.1 .025	0.1 .02	.205	.64
Carp (Juve)	0 0	0.7 .14	0.1 .025	0 0	.165	.52
Carp (Adult)	0 0	0 0	0.1 .025	0.1 .02	.045	.14
Channel Cat-fish (Juve)	0 0	0.6 .12	0.8 .20	0 0	.32	1.00
White Bass (Juve)	0 0	0.7 .14	0.5 .125	0 0	.165	.52
Spotted Bass (Juve)	0 0	0.6 .12	0.8 .20	0 0	.32	1.00
Largemouth Bass (Juve)	0 0	0.5 .10	0.8 .20	0 0	.30	.94
Largemouth Bass (Adult)	0 0	0.1 .02	0.5 .125	0.1 .02	.165	.52
Green Sun-fish (Juve)	0 0	0.5 .10	0.3 .075	0 0	.175	.55
Bluegill (Juve)	0 0	0.6 .12	0.2 .05	0 0	.17	.53
White Crappie (Juve)	0 0	0.6 .12	0.7 .175	0 0	.295	.92
Freshwater Drum (Juve)	0 0	0.5 .10	0.3 .075	0 0	.175	.55

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

TABLE 10

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH September

EVALUATION SPECIES (LIFE STAGE)	CRITERIA				RELATIVE VALUE	RELATIVE VALUE INDEX
	(1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2		
Gizzard Shad (Juve)	0 0	0.8 .16	0.1 .025	0.1 .02	.205	.64
Carp (Juve)	0 0	0.7 .14	0.1 .025	0 0	.165	.52
Carp (Adult)	0 0	0 0	0.1 .025	0.1 .02	.045	.14
Channel Cat-fish (Juve)	0 0	0.6 .12	0.8 .20	0 0	.32	1.00
Channel Cat-fish (Adult)	0 0	0 0	0.2 .05	0.2 .04	.09	.28
White Bass (Juve)	0 0	0.7 .14	0.5 .125	0 0	.165	.52
White Bass (Adult)	0 0	0.1 .02	0.1 .025	0.5 .10	.145	.45
Spotted Bass (Juve)	0 0	0.6 .12	0.8 .20	0 0	.32	1.00
Spotted Bass (Adult)	0 0	0.1 .02	0.6 .15	0.1 .02	.19	.59
Largemouth Bass (Juve)	0 0	0.5 .10	0.8 .20	0 0	.30	.94
Largemouth Bass (Adult)	0 0	0.1 .02	0.5 .125	0.1 .02	.165	.52
Green Sun-fish (Juve)	0 0	0.5 .10	0.3 .075	0 0	.175	.55
Green Sun-fish (Adult)	0 0	0.5 .10	0.5 .125	0.2 .04	.265	.83
Bluegill (Juve)	0 0	0.6 .12	0.2 .05	0 0	.17	.53
Bluegill (Adult)	0 0	0.6 .12	0.2 .05	0.2 .04	.21	.66
White Crappie (Juve)	0 0	0.6 .12	0.7 .175	0 0	.295	.92
White Crappie (Adult)	0 0	0.1 .02	0.3 .075	0.2 .04	.135	.42
Freshwater Drum (Juve)	0 0	0.5 .10	0.3 .075	0 0	.175	.55
Freshwater Drum (Adult)	0 0	0 0	0.2 .05	0.1 .02	.07	.22

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

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COOPER LAKE AND CHANNELS, TEXAS. SUPPLEMENT.(U)

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TABLE 11

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH October

EVALUATION SPECIES (LIFE STAGE)	CRITERIA				RELATIVE VALUE	RELATIVE VALUE INDEX
	(1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2		
Gizzard Shad (Juve)	0 0	0.8 .16	0.1 .025	0.1 .02	.205	.64
Gizzard Shad (Adult)	0 0	0.1 .02	0.1 .025	0.2 .04	.085	.27
Carp (Adult)	0 0	0 0	0.1 .025	0.1 .02	.045	.14
Channel Cat-fish (Juve)	0 0	0.6 .12	0.8 .20	0 0	.32	1.00
Channel Cat-fish (Adult)	0 0	0 0	0.2 .05	0.2 .04	.09	.28
White Bass (Juve)	0 0	0.7 .14	0.5 .125	0 0	.165	.52
White Bass (Adult)	0 0	0.1 .02	0.1 .025	0.5 .10	.145	.45
Spotted Bass (Juve)	0 0	0.6 .12	0.8 .20	0 0	.32	1.00
Spotted Bass (Adult)	0 0	0.1 .02	0.6 .15	0.1 .02	.19	.59
Largemouth Bass (Adult)	0 0	0.1 .02	0.5 .125	0.1 .02	.165	.52
Green Sun-fish (Juve)	0 0	0.5 .10	0.3 .075	0 0	.175	.55
Green Sun-fish (Adult)	0 0	0.5 .10	0.5 .125	0.2 .04	.265	.83
Bluegill (Juve)	0 0	0.6 .12	0.2 .05	0 0	.17	.53
Bluegill (Adult)	0 0	0.6 .12	0.2 .05	0.2 .04	.21	.66
White Crappie (Juve)	0 0	0.6 .12	0.7 .175	0 0	.295	.92
White Crappie (Adult)	0 0	0.1 .02	0.3 .075	0.2 .04	.135	.42
Freshwater Drum (Juve)	0 0	0.5 .10	0.3 .075	0 0	.175	.55
Freshwater Drum (Adult)	0 0	0 0	0.2 .05	0.1 .02	.07	.22

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

TABLE 12

INDICATOR SPECIES RATING BY RVI RANKING CRITERIA AND RELATIVE IMPORTANCE VALUES COOPER LAKE AND CHANNELS PROJECT

MONTH November and December

EVALUATION SPECIES (LIFE STAGE)	CRITERIA (1) FECUNDITY .35	(2) PREDATION (VULNERABILITY) .2	(3) COMPETITION .25	(4) RECRUITMENT .2	RELATIVE VALUE	RELATIVE VALUE INDEX
Gizzard Shad (Juve)	0 0	0.8 .16	0.1 .025	0.1 .02	.205	.77
Gizzard Shad (Adult)	0 0	0.1 .02	0.1 .025	0.2 .04	.085	.32
Carp (Adult)	0 0	0 0	0.1 .025	0.1 .02	.045	.16
Channel Cat-fish (Adult)	0 0	0 0	0.2 .05	0.2 .04	.09	.34
White Bass (Adult)	0 0	0.1 .02	0.1 .025	0.5 .10	.145	.55
Spotted Bass (Adult)	0 0	0.1 .02	0.6 .15	0.1 .02	.19	.72
Largemouth Bass (Adult)	0 0	0.1 .02	0.5 .125	0.1 .02	.165	.62
Green Sun-fish (Adult)	0 0	0.5 .10	0.5 .125	0.2 .04	.265	1.00
Bluegill (Adult)	0 0	0.6 .12	0.2 .05	0.2 .04	.21	.79
White Crappie (Adult)	0 0	0.1 .02	0.3 .075	0.2 .04	.135	.51
Freshwater Drum (Adult)	0 0	0 0	0.2 .05	0.1 .02	.07	.26

NOTE: FIRST NUMBER IN COLUMN REPRESENTS THE INDICATOR SPECIES' RATING FOR THAT RANKING CRITERIA. THE SECOND FIGURE IS THE PRODUCT OF THE RATING AND THE RELATIVE WEIGHT.

was the basic tool for evaluating stream habitat of the various study segments. Higher than normal average monthly flows in relation to median monthly flows of the study area are indicative of the high intensity short duration storms which have been recorded through the period of record. This fairly atypical hydrograph is also indicative, in part, of the inability of adjacent and upstream land areas to retard surface runoff. For the above reasons, the existing hydraulic conditions were simulated from median flows rather than average flows. Physical habitat in Weighted Useable Area (WUA) or Habitat Units (HU's) was calculated by using the hydraulic simulation output as input to the habitat model which includes all indicator species life stages preference ranges for depths and velocities. Although monthly median flows do not represent true "baseline" habitat conditions since actual daily streamflows are always lower or higher than the median, use of those simulated conditions appears to be a reasonable approach to quantifying existing conditions for comparison purposes.

The USFWS, after quantifying existing habitat conditions for all stream reaches, determined that a flow regime of 45 cfs in September through February, 50 cfs in March and April, and 30 cfs in May through August would constitute an optimum flow. This optimum flow was determined through the use of a "Reduction Matrix" which, in essence, selects flows for each month that least affect a matrix derived limiting species life-stage. This optimum flow was then defined by USFWS as the primary mitigation flow. Subsequently, habitat units were calculated for downstream (from the dam) segments by simulating flows of 1) 45-50-30 cfs, 2)35-40-20 cfs, 3)25-30-10 cfs, and 4)a continual 5 cfs release which is the currently proposed downstream low flow release. The Corps objection to the Reduction Matrix method is that it ignores the non-linear and even inverse relationships between flows and productivity for all indicators. The Reduction Matrix selects monthly flows which show the least habitat reduction for one (the most affected) species life stage.

Any continuous flow regime which is proposed for release downstream of a dam as mitigation for stream losses due to inundation should relate primarily to its ability to compensate for those losses. It is more appropriate to identify a release schedule which attempts to attain full compensation for ecosystem losses than, as was done by USFWS, to determine ideal or optimum conditions for key indicator species and then weight all other species for their management interest. This is especially true when all of the indicator species are better managed in lake situations. For this reason, the Fort Worth District conducted this evaluation which focuses on compensation potential rather than desirable downstream optimum conditions.

The habitat unit information provided by the USFWS includes total habitat units at median flow for the stream segments that would be inundated by the proposed lake. Habitat unit data were also provided by USFWS for all indicator species life stages, by month, for all stream segments downstream of the damsite for the median flow condition, for the USFWS

optimum flow and two contingency flows, and for the proposed 5 cfs low flow discharge. Each habitat unit for each species consists of a qualitative value and a quantitative value. The qualitative component of each habitat unit is its Habitat Suitability Index (HSI) which is a function of the species/life stage's preference for certain depths and velocities. The quantitative component of each habitat unit is a function of the amount of available depths and velocities (habitat) at a given flow.

By applying the RVI's which were developed for this Corps evaluation and identifed on Tables 3-12 to the habitat units provided by the USFWS, the relative importance of all life stages of all indicator species to the stream ecosystem may be accounted for. Table 13 provides a summary of the RVI weighted habitat units, totaled for monthly indicator species, for all flows for which habitat units were provided by the USFWS. Basic habitat unit data and the weighted habitat unit values for each indicator species, for each flow, for each month are on file in the Fort Worth District Office. For the purpose of determining project related losses to the stream ecosystem, the assumption was made that all stream habitat that would be inundated by the proposed lake would be lost. Therefore, those habitat units in the first column of Table 13, identified as LAKE AREA, are considered to be project caused habitat unit losses to the stream ecosystem. The second column represents the "baseline" habitat units for the downstream ecosystem by which various flow regimes may be analyzed for their compensation potential.

The ability of each flow which was analyzed to compensate for identified stream habitat losses is displayed in Table 14. The percent compensation of each plan was computed by subtracting the baseline downstream weighted habitat units from the weighted habitat units attributable to a given flow and then dividing by the losses. For example, compensation of the USFWS contingency plan 2 for the month of February is computed as follows:

$$\% \text{ Compensation} = \frac{\text{HU's of Contingency Paln 2 - Baseline HU's}}{\text{LAKE AREA HU's}}$$

or:

$$\% \text{ Compensation} = \frac{64{,}398{,}359 - 63{,}734{,}676}{12{,}340{,}354} = 5\%$$

It may be noted from Table 14 that, in most months, no linear relationship exists between flows and habitat units or compensation potential. For this reason it was determined that interpolation between or extrapolation beyond those identified points would be questionable.

<u>Identification of Maintenance Flow.</u> Section 102(b) of the Clean Water Act (PL95-217) gives the Corps the authority to determine the need for storage for streamflow regulation in any water resource project in a

TABLE 13

TOTAL WEIGHTED HABITAT UNITS FOR ALTERNATIVE FLOW REGIMENS

MONTH	PLAN					ALLOCATED RELEASE
	LAKE AREA (MEDIAN FLOW)	DOWN STREAM (MEDIAN FLOW)	FWS PRIMARY PLAN	FWS CONTINGENCY PLAN 1	FWS CONTINGENCY PLAN 2	
JANUARY	9,474,441	66,107,001	64,808,031	72,053,443	68,884,933	58,399,970
FEBRUARY	12,340,354	63,734,676	65,367,976	64,227,613	64,398,359	62,018,288
MARCH	13,164,395	56,731,873	55,305,713	54,469,636	56,289,186	56,199,819
APRIL	19,589,675	123,353,584	111,046,309	113,664,266	122,548,138	120,758,505
MAY	23,426,907	115,310,475	119,244,949	126,892,752	121,394,366	121,138,876
JUNE	17,268,696	112,247,013	105,418,207	106,953,355	112,249,012	107,487,450
JULY	12,355,028	120,861,110	122,656,737	122,246,855	120,044,012	112,979,247
AUGUST	8,114,411	56,507,859	93,661,784	93,811,638	94,119,881	78,807,450
SEPTEMBER	9,665,062	75,599,684	144,522,439	149,722,758	149,654,405	110,118,663
OCTOBER	5,647,593	94,596,933	123,464,103	120,571,877	109,409,024	109,980,763
NOVEMBER	4,394,795	69,560,289	81,516,084	77,709,004	76,043,321	69,180,846
DECEMBER	9,087,719	75,558,402	77,069,662	82,815,802	80,587,712	68,011,669

TABLE 14

PERCENT COMPENSATION FOR ALTERNATIVE FLOW REGIMENS

MONTH	PLAN			
	FWS PRIMARY PLAN	FWS CONTINGENCY PLAN 1	FWS CONTINGENCY PLAN 2	ALLOCATED RELEASE
JANUARY	-14%	63%	29%	-81%
FEBRUARY	13%	4%	5%	-14%
MARCH	-11%	-17%	- 3%	- 4%
APRIL	-63%	-49%	- 4%	-13%
MAY	17%	49%	26%	25%
JUNE	-40%	-31%	1%	-28%
JULY	14%	11%	- 7%	-64%
AUGUST	405%	460%	464%	275%
SEPTEMBER	713%	767%	766%	357%
OCTOBER	511%	460%	262%	272%
NOVEMBER	272%	185%	148%	- 9%
DECEMBER	17%	79%	55%	-80%

planning stage. Maintenance flows for this purpose have been identified by the Fort Worth District as minimum instantaneous flow designed to provide needed flow during critical periods and to sustain short-term survival habitat for most aquatic life forms. These flows are in no way related to mitigation for stream losses due to the water resource project.

A number of methods are available which provide estimates of maintenance flows. Two of the quickest and easiest to use are the "Montana Method" or "Tennant's Method" developed by the U.S. Fish and Wildlife Service in 1975, and the "Modified Tennant's Method" developed and implemented for all Texas streams in 1979 by the Texas Parks and Wildlife Department (FAP-F-30-R-4, Statewide Minimum Streamflow Recommendations, TPWD, October 16, 1979).

With the Montana Method, biological analyses are accomplished with the aid of available hydrological data. It is a method for determining flows to protect the aquatic resources in both warm-water and cold-water streams based on their average flow. The method was developed through detailed field studies which were all planned, conducted, and analyzed with the help of state fishery biologists. Although results of the studies reveal that the condition of the aquatic habitat is remarkably similar on most streams carrying the same portion of the average flow, and results are consistent from stream to stream and state to state, this method was not applied for the Cooper Lake Project. As was the case in utilizing the Incremental Method to habitat unit values, the short duration, high intensity storm events through the period of record provide an average flow which unrealistically depicts the nature of the aquatic habitat.

The TPWD, recognizing that most of the initial work on instream or maintenance flow methodologies was done in the mountainous western states, initiated a study to determine minimum streamflows needed to sustain Texas stream fisheries. To establish minimum flow recommendations, the TPWD conducted a review of the available literature on streamflow methodologies. Flow percentages used in the Montana Method and the use of median monthly flows as recommended by other works were combined to provide the "Modified Tennant's Method" used for their recommendations. Validation of this method was by field evaluation below Canyon Reservoir in February 1977, with the aid of the Guadalupe-Blanco River Authority and the Fort Worth District. Criteria used in developing this methodology was that it should be easy to use, realistic, useable on all sizes of streams, adaptable to a particular fishery, meaningful and capable of mimicking natural flow patterns. According to the TPWD, their Modified Tennant's methodology meets those criteria and validation on the Guadalupe River suggests that the method is valid for Texas stream fisheries.

Results of application of the Modified Tennant's Method to the South Sulphur River at the proposed damsite are displayed below. Median flows over the period of record are also displayed.

MONTH	J	F	M	A	M	J	J	A	S	O	N	D
MEDIAN FLOW	19	30	31	19	31	12	1	0.1	0.3	1	5	13
MAINTENANCE FLOW	8	12	19	11	19	7	1	0	0	0	2	5

Again, because of the disparity between average and median flows at the damsite in relation to other streams in Texas and the midwest, median flow appears to be more appropriate than average flow for the determination of instream maintenance flow needs. The above maintenance flow identified through application of the Modified Tennant's Method as recommended by the TPWD, has therefore been identified as the baseline condition for maintenance of the downstream fisheries resource. The currently proposed 5 cfs minimum low flow is greater than or equal to this maintenance flow 6 months of the year, but is somewhat less in 6 months of the year.

Discussion. By applying an ecological approach which accounts for ecosystem functions to the evaluation of habitat unit data provided by the USFWS, the Corps has made a determination of the degree of compensation by month for four alternative flow regimes (Table 14). The ability of a flow to compensate for stream losses is based on the assumption that stream segments to be inundated by the lake have a value which is not replaceable by lake habitat. An assumption is also made that stream habitat losses are quantifiable and that those quantified losses may be replaced, in kind, by adjusting flows downstream from the dam.

It is within the Corps authority to determine what flows are necessary to maintain the downstream fisheries resource. That maintenance flow has been determined and is displayed on Table 15. It is the policy of the Corps of Engineers to plan projects which minimize environmental losses, and if losses are unavoidable to significant resources, to mitigate for those losses. Recommendations provided by the USFWS indicate that losses of stream habitat will occur with implementation of the project and that those losses would not be effectively mitigated by the aquatic habitat provided by the lake. The basis for the USFWS determination that lake habitat will not replace stream habitat is that in the project area, lakes are abundant and easily constructed but stream habitat is scarce, diminishing, and not easily replaced. If this premise is accepted, then a number of downstream flow regimes have been identified which would at least partially compensate, in kind, for stream habitat losses, as quantified through the use of "indicator" species which in reality would all recieve habitat gains with the lake.

Three questions surface at this point which must be answered when considering recommendation of mitigation measures. First, are losses to the stream system accurately depicted by the "indicator" species used in the habitat evaluation? The second question is whether or not the identified compensation flows would, in reality, replace habitat lost to true stream species. Finally, and most importantly, is the stream habitat that is lost a significant resource which should be mitigated?

TABLE 15
MITIGATION ANALYSIS

MONTH	MAINTENANCE FLOW (CFS)	CORPS DETERMINED MITIGATION (CFS)	(% COMPENSATION)
JANUARY	8	25	29%
FEBRUARY	12	25	5%
MARCH	19	30	-3%
APRIL	11	30	-4%
MAY	19	20	49%
JUNE	7	10	1%
JULY	1	10	-7%
AUGUST	0	5	275%
SEPTEMBER	0	5	357%
OCTOBER	0	5	272%
NOVEMBER	2	25	148%
DECEMBER	5	25	55%

In their Planning Aid Letter, the USFWS contends that the selected indicator species can and do represent the quantity and quality of one stream segment relative to another and that no attempt should be made to relate stream habitat to lake habitat. Of the ten indicator species used in the analysis, green sunfish and white crappie are probably the most viable indicators of the stream segments to be inundated based on stream habitat preferences. Though the other indicator species actually prefer the habitat provided by larger stream segments there no doubt is habitat for some life stages provided by the stream segments of the area to be inundated. It appears that these losses are fairly accurately depicted through the use of RVI's (weighting for ecosystem functions) in this habitat evaluation. What is not depicted are the losses that would occur to true stream species which are almost entirely dependent on the small streams, pools, backwater, and intermittent tributaries of the area that would be inundated by the lake. Species which are dependent on this habitat for spawning and survival and which are listed as occurring in the study area include among others, stoneroller, blackspot shiner, suckermouth minnow, freckled madtom, pirate perch, bantam sunfish, and the redfin, goldstripe, and scaly sand darters. These species are fairly limited in distribution and their habitat is diminishing due to inundation, channelization, and changing land use patterns.

When RVI's are applied to the life stages of the indicator species, the habitat units computed for the various flows analyzed appear to reasonably track the compensation potential of those flows. Considering the fact that the indicator species do occur in both the upstream and downstream segments; considering that true stream species which were not used as indicators also occur in all segments; and considering that there are numerous unfilled niches with the selected indicator species which, in reality, would be filled by true stream species; it appears that use of the selected indicator species, when weighted for ecosystem functions, is reasonable as an approach to determining losses caused by inundation and compensation potential of various flows.

Table 15 presents the identified TPWD fisheries maintenance flow and a mitigation flow developed by the Corps interpretation of USFWS data which are based on "indicator" species. The mitigation flow was determined by comparing the maintenance flow requirements with the compensation potential of the flows analyzed in the habitat evaluation of the Fort Worth District (Table 14). An attempt was made to select the largest degree of compensation while selecting a discharge not too far out of line with the identified maintenance flow. An analysis of the Corps determined mitigation, which is based on lake-type indicator species, against the habitat requirements of true stream species, indicates an apparent logical correlation. With the Corps determined mitigation flows of 30 cfs in March and April, no compensation is provided, in fact, net losses of 3 and 4 percent respectively are indicated. This corresponds well with the life histories of true stream species which would definitely suffer habitat losses due to inundation of the small headwater tributaries and creeks such as Doctor's and Journigan. The net losses on

Table 15 for those months are indicative of spawning habitat losses for stream species for those months. Conversely, however, survival habitat during most other months, with the exception of the anomalous month of July, would be greatly increased in the downstream segments with the Corps determined mitigation flow. The fact that small tributary spawning habitat will still remain in such downstream tributaries as Brushy Creek, Post Oak Creek, Morgan Creek and numerous others in conjunction with increased mainstem survival habitat indicates that a reasonable trade-off has been made in the analysis.

Legal analysis-instream flows, water rights. The constraints identified to making additional continuous releases for instream flow or stream mitigation purposes, as requested by USFWS, include signed contracts with local sponsors, and the authority of the State of Texas to control the allocation and appropriation of water for beneficial use. Typically, the initiation of an appropriative water right is said to require the following steps:

a. The intent to appropriate water

b. Notice to others of the appropriation

c. Compliance with State prescribed formalities

d. Application for the water to beneficial use

e. A diversion of the water

The modern State water rights permit system makes satisfaction of the first two requirements automatic since application for a permit evidences the intent of the appropriator and the granting of the permit provides notice to others of the appropriation. Satisfaction of the third requirement is simply a matter of following certain prescribed procedures and poses no unique problems for protecting instream values. However, the remaining two requirements can cause problems for instream flow appropriations.

The appropriative right as recognized in the western states is, and always has been, a right of beneficial use of water. Fundamental in western jurisprudence, the concept of beneficial use in the many relevant statutes and court decisions is general and without significant dissent, irrespective of geographical location.

Currently, provisions in the constitutions of 10 western states, including Texas, relate the appropriative right to the use of water to beneficial use, and nearly all western states contain positive declarations of the relationship between appropriative rights and the beneficial use of water (see Clark, Waters and Water Rights, Volume 1, Section 19.2, page 86).

This requirement of a beneficial use of the water may create difficulties in obtaining an instream appropriation.

In the earlier court decisions, esthetic, recreational, and wildlife propagation considerations were not deemed acceptable as the basis of a valid appropriation of water. For example, a Federal court in Colorado held that an appropriation could not be made to assure the continued flow of a stream through a canyon, the chief value of which was the scenic attraction of its waterfalls (see Empire Water and Power Co. v. Cascade Town Co., 205 Fed. 123, (CA-8 Colo., 1913). And the Utah Supreme Court has rejected a claim of appropriation for irrigation of uninclosed and unoccupied public land for the sole purpose of propagating wild waterfowl (see Lake Shore Duck Club v. Lake View Duck Club, 166 Pac. 309 (1917). In recent years, however, the importance of recreation and wildlife propagation as beneficial uses of water has been recognized in many state statutes.

In Oregon, both "public recreation" and "scenic attraction" are named in the water rights statutes as uses in the public interest (see Ore. Rev. Stat. Articles 537.170 and 543.225). In Texas, water may be appropriated for "game preserves, recreation, and pleasure (see Tex. Rev. Civ. Stat. Art. 7470). In addition, Colorado has enacted a statute giving general recognition to the beneficial nature of instream uses. It did so by defining beneficial use to include appropriations by the State of "minimumflows...required to preserve the natural environment to a reasonable degree" (see Colo. Rev. Stat. Ann. Art. 39-93-103(4). See also Cal. Water Code Art. 1243(1975) and Mont. Rev. Code Ann. Art. 89-867(2) (1974) - (fish and wildlife and recreational uses).

Because of these statutory trends in support of the preservation of natural resources, it is unlikely that courts would now decide that instream uses are per se nonbeneficial, but the extent to which these uses can displace more traditional uses still remains unclear.

The legislative definition of "beneficial use" in Texas is the use of such a quantity of water, when reasonable intelligence and reasonable diligence are exercised in its application for a lawful purpose, as is economically necessary for the use (see Tex. Rev. Civ. Stat. Art. 7476). After defining beneficial use in general terms, the legislature went on to enact an administrative control statute which lists several beneficial uses for which water may be appropriated. Tex. Rev. Stat. Art. 7470 codified as Section 11.023 of the Texas Water Code, states:

"Art. 11.023. Purposes for which water may be appropriated:

a. State water may be appropriated, stored, or diverted for:

(1) domestic and municipal uses, including water for sustaining human life and the life of domestic animals;

(2) industrial uses, meaning processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, including the development of power by means other than hydroelectric;

(3) irrigation;

(4) mining and recovery of minerals;

(5) hydroelectric power;

(6) navigation;

(7) recreation and pleasure;

(8) stock raising;

(9) public parks; and

(10) game preserves.

b. State water also may be appropriated, stored, or diverted for any other beneficial use.

c. Unappropriated storm water and floodwater may be appropriated to recharge underground freshwater bearings sands and aquifers in the portion of the Edwards underground reservoir located within Kinney, Uvalde, Medina, Bexar, Comal, and Hays Counties if it can be established by expert testimony that an unreasonable loss of State water will not occur, and that the water can be withdrawn at a later time for application to a beneficial use. The normal or ordinary flow of a stream or watercourse may never be appropriated, diverted, or used by a permittee for this recharge purpose.

d. When it is put or allowed to sink into the ground, water appropriated under Subsection c of this section loses its character and classification as storm water or floodwater and is considered percolating groundwater.

e. The amount of water appropriated for each purpose mentioned in this section shall be specifically appropriated for that purpose, subject to the preferences prescribed in Section 11.024 of this code.

f. The water of any arm, inlet, or bay of the Gulf of Mexico may be changed from salt water to sweet or fresh water and held or stored by dams, dikes, or other structures and may be taken or diverted for any purpose authorized by this chapter." (emphasis added.)

The above list of beneficial uses for which water may be appropriated have been set out in order of priority as follows:

"(1) domestic and municipal uses, including water for sustaining human life and the life of domestic animals;

(2) industrial uses, meaning processes designed to convert materials of a lower order of value into forms having greater usability and commercial value, including the development of power by means other than hydroelectric;

(3) irrigation;

(4) mining and recovery of minerals;

(5) hydroelectric power;

(6) navigation;

(7) recreation and pleasure; and

(8) other beneficial uses."

(See Section 11.024 of the Texas Water Code.)

A review of the above statutes shows that although they specifically enumerate certain uses deemed to be beneficial, they do not exhaust the meaning of beneficial use in Texas. It has been held that the term itself is operational and must be tested pragmatically in each situation and by every decision (see City of Denver v. Sheriff, 96 P.2d 836 (1939)).

As stated above, the usual purposes for which rights to the use of water may be acquired are listed in paragraph (a), Section 11.023 of the Texas Water Code. Wildlife mitigation is not included in this listing. However, paragraph (b) of Section 11.023 states that "State water also may be appropriated, stored, or diverted for any other beneficial use." (emphasis added). The fact that a particular purpose of use of water is omitted from the list of purposes for which water may be appropriated does not necessarily stigmatize it legislatively as nonbeneficial. Hence, if actually beneficial in a particular instance, an unlisted purpose of use such as wildlife mitigation should be acceptable for inclusion in an application to appropriate water. (See State Department of Parks v. Idaho Department of Water Administration, 530 P.2d 924 (1974)).

The requirement for a diversion is an obvious obstacle to allowing mitigation flows since such instream appropriations by their very nature do not involve a diversion. This requirement was invoked by a California state administrative agency in 1961 and by the Colorado Supreme Court in 1965, to prevent state agencies from appropriating water for public recreation and fish and wildlife maintenance. (See California Water Rights Board Decision 1030 (1961) and Colorado River Water Conservation Dist. v. Rock Mt. Power Co., 406 P.2d 798 (1965)).This diversion requirement was also reaffirmed in the 1972 New Mexico decision of State v. Miranda, 493 P.2d 409 (1972)).

As much as the diversion requirement has been criticized in recent years, it still remains a deeply ingrained part of the appropriation doctrine and presents a serious obstacle to instream appropriation. One way to eliminate the obstacle is for the legislature of a state to statutorily declare that the diversion requirement is no longer necessary. This is exactly what the Colorado Legislature did following the Colorado River Conservation District case (see Colo. Rev. Stat. Ann. Art.

37-92-102(3)(1973)). Both Idaho and Washington have recently enacted similar legislation. However, Texas has not enacted any legislation which would allow a mitigation flow to continue in the streambed and not be subject to downstream appropriation. Not until such legislation is enacted can new appropriations for such instream uses be made.

Conslusions and Recommendation. Assuming a fairly realistic representation of the stream ecosystem through the use of selected indicator species, compensation can be achieved for identified stream habitat losses on an annual basis. If it is assumed that the spawning months are more important than other months, then those months (March, April, May, and June) may be weighted to reflect their importance. Assuming that the spawning months are twice as important to system success, the compensation potential of the Corps determined mitigation flow on an annual basis would be 76 percent. If, however, it is assumed that each month, including the critical low flow summer months, is equally important, as is the position of the Corps, the mitigation flow would provide 98 percent compensation on an annual basis.

Notwithstanding the determination of what flow constitutes appropriate stream habitat mitigation, either by the USFWS or Corps of Engineers, there still remains a lack of Federal authority to implement such a mitigation flow. The allocation and use of water, including the protection of the normal or ordinary base flow of a stream from appropriation or diversion, remains a State authority.

The Corps further believes that the stream resource inundated by Cooper Lake, is not a resource which has demonstrated national or local significance and, therefore, would not warrant the allocation of water to mitigation purposes through increased flows. There are currently no Federal mechanisms to insure such a mitigation flow, if released from Cooper Dam, would remain in the stream as it would still be subject to appropriation and use for other beneficial purposes.

The provision of a 5 cfs minimum low flow release, and the flexibility gained by supplementing this release with captured flood storage, which TDWR has not objected to, will allow the provision of instream flows below Cooper Dam in accordance with the recognized contract constraints, and Federal policy relating to the State's authority to control the use of water within the State's boundaries.

In addition to these flow recommendations, which the State has not objected to, the Corps aquatic mitigation plan consists of other measures to offset stream fisheries losses. These include a significant improved public access to the stream resource, a tailwater fishing facility, and a very significant increase in lake habitat available for 50% of the species currently existing in the South Sulphur River.

APPENDIX B
EXHIBIT 2
PLANNING AID LETTERS AND COORDINATION ACT REPORT
STUDIES FOR THE SUPPLEMENTAL EIS

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

300 East 8th St., Rm. G-121
Austin, Texas 78701

February 9, 1981

Colonel Donald J. Palladino
District Engineer
U.S. Army, Corps of Engineers
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

This letter and the attached Substantiating Report constitutes our Fish and Wildlife Coordination Act report for the Cooper Lake and Channels Project, Texas. Fish and Wildlife Service studies have been accomplished under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended, 16 U.S.C. 661 et seq.) and this report constitutes the report of the Secretary of Interior as defined in Sec. 2(b) of that Act.

Our studies have been cooperatively conducted with your staff and the Texas Parks and Wildlife Department (TPWD). This report has the concurrence of the Department as indicated by the enclosed copy of a letter dated January 29, 1981, from Executive Director Charles D. Travis.

Cooper Lake and Channels Project, Texas was authorized for construction by Public Law 218 in 1955. Studies by your agency were initially conducted by the New Orleans District of the Corps of Engineers until they were transferred to the Fort Worth District Corps of Engineers in September 1979. Concurrent with this transfer, Region 2 of the Fish and Wildlife Service (FWS) accepted the assignment of this project from Region 4, and appointed the Fort Worth Ecological Services Office the task of making studies/evaluations and preparing this report.

Prior to the project being transferred from the New Orleans District of the Corps it was enjoined from completion in 1971 by the U.S. District Court of the Eastern District of Texas. The Final Environmental Statement (FES) was filed in 1973, but on December 8, 1978, the court issued a Memorandum Opinion detailing inadequacies in the FES. A Supplemental Environmental Statement (SES) was required and the FWS assisted your agency by supplying several planning aid letters during 1979 and 1980. Those letters, together with the attached Substantiating Report provide the Service's analysis, evaluations and recommendations for the project.

The Cooper Dam will be located on the South Sulphur River, at mile 23.2, with the project in Bowie, Cass, Delta, Franklin, Lamar, Hopkins, Morris, Red River and Titus Counties, Texas and in Miller County, Arkansas. Project purposes include water supply, flood control and recreation.

The dam will be about 73 feet high and 15,900 feet long and the flood control pool will have a surface area of about 22,700 acres. Cooper Lake is expected to have a yield of 109 million gallons of water per day (mgd). Structural alternatives, pertinent data, and other detailed information, analysis, evaluations, conclusions and recommendations are herewith provided in the attached Substantiating Report.

A section in the Substantiating Report, entitled Human Use and Monetary Analysis provides information on project effects to year 2089, based on project construction starting in year 1990.

The Service's Habitat Evaluation Procedures (HEP) has been used for analysis and evaluations in addition to its Instream Flow Methodologies. Personnel of your agency have worked closely with the Fort Worth Service Office in deriving the presented data.

The FWS studies/evaluations conclude that the project plans of the Corps of Engineers, if implemented as currently drawn, will provide inadequate mitigation for aquatic resources lost with the project. The Service accepts your terrestrial mitigation plans with the understanding that this agency will be provided full opportunity to study and provide recommendations on remaining project alternatives.

Based upon the information provided prior to January 26, 1981 by your agency, the Fish and Wildlife Service recommends that:

1. The Corps of Engineers adopt and implement the following schedules for Cooper Lake:

    a. Upon completion of the impoundment structure, a continuous release of 5 cfs be implemented until normal operating level is reached or until Stage 1 is reached.

    b. Once the normal operating level or Stage 1 is reached, a continuous release schedule of (1) 45 cfs for months September through February, and (2) 50 cfs for the months March and April, and (3) 30 cfs for the months of May through August be implemented.

    c. During a mild drought period (ex. one-in-four year low flow), the above recommendation (1b) be reduced by 10 cfs.

    d. During a more significant drought period (ex. one-in-seven year low flow) the recommendation be reduced to (1) 25 cfs for the months of September through January, (2) 35 cfs for the months February and March, (3) 25 cfs for April, (4) 20 cfs for May, (5) 14 cfs for June and (6) 10 cfs for the months of July and August.

e. During a severe drought period (ex. one-in-ten year low flow), the recommendation be reduced to a continuous release of 5 cfs for all months.

2. Cooper Lake be impounded in two phases to complement the water supply/demand analysis.

3. The Corps of Engineers proceed with the terrestrial habitat mitigation plan as presented in the Draft Supplement Environmental Statement.

4. The terrestrial mitigation plan be implemented concurrent with project construction.

5. When the terrestial mitigation area has been acquired in fee simple title, its boundary line fenced and the initial plantings of selected flora completed by the Corps of Engineers, the area be transferred to the Texas Parks and Wildlife Department for administration under terms of a General Plan in accordance with the provisions of and under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

6. The Fish and Wildlife Service be provided an opportunity to participate in the preparation of the Master Plan for Cooper Lake project.

The Service appreciates the opportunity to participate in project planning. Joint team efforts by our agencies have materially assisted in meeting the short deadlines for this complicated project.

If project plans are altered from those presented in this report, the Service requests that your agency provide the transfer funding to this agency and the opportunity to study and provide recommendations on those changes in plans.

Sincerely yours,

W. Ellis Klett

W. Ellis Klett
Area Manager

cc: Ecological Services, U. S. Fish and Wildlife Service, Fort Worth, TX
Regional Director, U. S. Fish and Wildlife Service, Albuquerque, NM
Texas Parks and Wildlife, Austin, TX

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January 29, 1981

Mr. Jerome L. Johnson
Field Supervisor
U. S. Fish & Wildlife Service
Ecological Services
9A33 Fritz Lanham Bldg.
819 Taylor Street
Fort Worth, Texas 76102

Re: U. S. Fish & Wildlife Service Report
On Cooper Lake And Channels Project

Dear Mr. Johnson:

The referenced document has been reviewed by this Agency, and my staff concurs with the recommendations offered in the report. Members of my staff from both the Fisheries and Wildlife Divisions have been active with your personnel in developing proposed mitigative alternatives and it is my understanding that this coordination will continue. It should be emphasized that the acceptance of any management responsibilities for any mitigative lands will be subject to the approval of the Texas Parks and Wildlife Commission.

The opportunity to coordinate with you on this matter is appreciated.

Sincerely,

Charles D. Travis
Executive Director

CDT:JR:gv

Appendix B
Exhibit 2

SUBSTANTIATING REPORT

THIS REPORT PREPARED IN

FORT WORTH, TEXAS

ECOLOGICAL SERVICES OFFICE

BY

EDWARD LYLES,

DENWOOD BUTLER,

AND

BILLY COLBERT

REVIEWED BY

JEROME L. JOHNSON, FISH AND WILDLIFE ADMINISTRATOR

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COOPER LAKE AND CHANNELS PROJECT, TEXAS

INTRODUCTION

This report details the effects of the authorized Cooper Lake and Channels Project, Texas, on the fish and wildlife resources of the Sulphur River Basin. This report has been prepared under the authority of and in accordance with the provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.) and is the report of the Secretary of the Interior under Sec. 2(b) of the Act. It replaces previous reports of July 3, 1966, March 8, 1972, and September 3, 1976. The report has the concurrence of the Texas Parks and Wildlife Department as stated in the letter dated January 29, 1981, signed by Executive Director Charles D. Travis.

The Cooper Lake and Channels Project was originally authorized for construction by Public Law 218, Chapter 501, 84th Congress, 1st Session approved August 3, 1955. The authorized Cooper Dam would be located at mile 23.2 on the South Sulphur River (see Plate 1). The Sulphur River Basin is located in northeast Texas and southwest Arkansas. Project purposes are water supply, flood control, and recreation.

The project was enjoined from completion in 1971, by the U.S. District Court of the Eastern District of Texas pending completion of a Final Environmental Statement (FES). Planning, land acquisitions, and other nonconstruction activities were permitted to continue. The FES was filed in June, 1973, but on December 8, 1978, the court issued a memorandum opinion detailing five inadequacies of the FES. These five inadequacies were:

(1) absence of state agency comments, and failure to address those comments that were made;

(2) failure to set out, concurrently with implementation of the project, adequate mitigation measures for losses of fish and wildlife;

(3) failure to discuss the alternative of a water supply project without provision for flood control;

(4) inadequate explanation of nonstructural flood control management; and

(5) bias in presentation of cost-benefit ratios and failure to analyze those presented.

Following this action, the Corps of Engineers (CE) initiated new studies to address these points and to complete a Supplemental Environmental Statement (SES). The U.S. Fish and Wildlife Service (FWS) has been a part of this recent planning effort and close coordination has occurred between the FWS and CE. It has resulted in the selection of four alternatives which were considered feasible for more detailed study. Therefore, discussion of earlier phases of the planning process are only briefly addressed.

The purpose of the FWS efforts was to provide the CE with planning assistance to aid in the completion of the SES and to update the Fish and Wildlife Coordination Act responsibilities. Several planning aid letters were provided by the FWS during 1979 and 1980 during the planning process. The contents of those reports form the basis of this report. The purpose of this report is to formally present the details of our studies and present recommendations for the mitigation of the fish and wildlife resources and their habitats that would be affected.

DESCRIPTION OF THE AREA

The Sulphur River basin originates in northeast Texas, flows easterly to the Red River in southwest Arkansas, and provides drainage for portions of eleven counties in Texas and one in Arkansas. The basin averages about twenty-five miles in width, is approximately 150 miles in length and is estimated to drain 3,700 square miles of land. Flooding, especially in the spring, is a frequent event along the Sulphur and its major tributaries. The flood plain ranges from one to two miles in width throughout the majority of the basin and widens to five miles near the Red River confluence. Bottom gradients along the natural portions of the river vary from one-half to five feet per mile, while the channelized segments maintain a more uniform slope of five feet per mile.

Climate is typically subtropical and dominated by Gulf breezes. Average monthly temperature ranges from 44^{O}F in January to 83^{O}F in August. The growing season is approximately 255 days and the average annual precipitation is 41 inches. The average annual streamflow, based on 37 years of record at the gage near Talco is 415 cubic feet per second (cfs).

Three major vegetational belts, each running from northeast to southwest, are controlled by soil type and available moisture. The Pineywoods area, composed primarily of pine and pine-hardwood forests, is located in the eastern portion of the basin. These forests are restricted to the acid upland soils bordering the flood plain. The central portion, referred to as the Post Oak Savannah area, which is dominated by slightly acid claypan soils, is characterized by oak-hickory forests, interspersed with mid to tall grass prairies. The western third of the basin consists of the Blackland Prairie Area which is typified by mid to tall grasses growing in neutral to slightly basic, dark clayey soils. Generally, trees are found only along streams, roads, fence rows, and around residences.

Bottomland hardwoods previously dominated the flood plains of all three vegetational areas; however, many of these forests have been cleared for agricultural purposes, which now dominate land use in the basin. Aside from commercial timbering, other agricultural land uses include cattle grazing and farming for hay, cotton, sorghum and soybeans.

Demographic data indicate that about fifty-nine per cent of the basin's urban population, according to the 1970 census, is located in the cities of Texarkana (Texas portion, population 30,497), Paris (23,441), Greenville (22,043), and Sulphur Springs (10,642). Between 1960 and 1970, the area showed a relatively slow net growth with an immigration rate of 1.2 as compared to 1.5 for the State of Texas.

PLAN OF DEVELOPMENT

Subsequent to early planning accomplishments between the CE and FWS, four project alternatives, including a comprehensive non-structural alternative, were selected for further evaluation. All plans were evaluated on a 100 year period of analysis (1990-2089). Summary data describing the structural alternatives are presented in Table 1. The non-structural alternative is dependent on voluntary land use within two defined flood frequency zones. Land use within the 3-year frequency flood plain, which contains 66,200 acres, would be allowed to remain as wildlife habitat. Approximately 24,200 acres of this zone were recommended for public use. Within the zone between the 3-year and 30-year flood plain, more intensive cultivation would be allowed. These compatible uses include grazing, row crops, selective timber harvest, and wildlife habitat. Above the 30-year flood plain, use is restricted to grazing to minimize erosion. The non-structural plan also incorporates other features such as enrollment in the National Flood Insurance Program, maintenance of existing flood prevention levees, and flood-proofing two existing houses near State Highway 37.

The plan which was selected for recommendation in the SES is a modification of the plan recommended in the FES. No new channels or levees are proposed within this plan. Table 2 outlines the pertinent data related to the recommended plan.

AQUATIC RESOURCES

The aquatic aspects of Cooper Lake and Channels Project were updated to include results originating from the most current state-of-the-art methods available to the fish and wildlife biologist. The Habitat Evaluation Procedures (HEP) were used for documenting the assessment, while the Physical Habitat Simulation Model (PHABSIM) was used for quantifying and qualifying stream habitat.

The Water Surface Profile (WSP) hydraulic simulation model is the first of two subroutines contained in PHABSIM and simulates the velocity and depth changes in the stream as flow is varied. The second subroutine (HABTAT) joins pertinent life history information (probabilities of use for a variety of velocities and depths) with the velocity and depth output from the WSP program.

The selection of evaluation species was based upon inventories supplied by the Texas Parks and Wildlife Department and the availability of life

Table 1. Structural Alternatives Selected for Further Evaluation

Cooper Lake and Channels Project, Texas

Alternatives	Yield (cfs)	Elevation (feet above mean sea level (msl))	Surface Area (acres)	Minimum Downstream Release (cfs)
Cooper Lake Without Flood Control				
Water Supply Pool	169	440.0	19,305	5 cfs
Guide-Taking Line		445.0	22,075	
Cooper Lake and Channels As Recommended in the FES				
Water Supply Pool	169	440.0	19,305	5 cfs
Guide-taking Line		459.8	30,000	
Cooper Lake with Flood Control, No New Channels or Levees (Currently Recommended Plan)				
Water Supply Pool	169	440.0	19,305	5 cfs plus 5% retention of floodpool
Guide-Taking Line		459.8	30,000	

Table 2. Pertinent Data Sheet for Cooper Lake, Cooper Lake and Channels Project, Texas (Currently Recommended Project)

Dam
Type: Rolled earthfill (lake side of dam will have an 18-inch blanket of riprap)
Height: 73 feet maximum, 40 feet average
Length: 15,882 feet
Crest Elevation: 459.feet m.s.l.

Service Spillway
Type: Controlled Ogee
Gates: Five 40 foot by 20 foot tainter gates
Length of Crest: 200 feet (net)
Crest Elevation: 426.2 feet msl

Outlet Works

Number	Size	Location
4	6 feet x 6 feet	398 m.s.l.
1	2 feet x 3 feet	422 m.s.l.
1	2 feet x 3 feet	436 m.s.l.

Reservoir Capacity

Pool Description	Elevation Feet, m.s.l.	Pool Storage Capacity Acre-Feet	Surface Area (Acres)
Sediment	415.5	37,000	5,084
Water Supply	440.0	273,000	19,305
Flood Control	446.2	131,400	22,740
Reservoir Yield		169 cfs 1/	109 mgd 2/

1/ The CE is proposing to use 5 cfs of this for a minimum flow release

2/ Millions of gallons per day

history information collated by the FWS Cooperative Instream Flow Service Group in Ft. Collins, Colorado. Seasonal occurrence of key life history stages was determined via a literature review. This information is presented in Table 3.

Streamflow measurements were obtained for 18 representative stream reaches throughout the project area. These measurements served to calibrate the WSP program. Twelve of these segments defined the streams in the area to be inundated by the proposed reservoir while six segments defined the affected downstream areas below the proposed damsite. Collectively, these reaches quantified existing conditions.

Future Without the Project

The Sulphur River does not provide a high quality fishery but does provide recreational opportunities, primarily catfishing, for local residents. Past land use changes have contributed to marginal water quality conditions. High dissolved solids and turbidity and low dissolved oxygen occur during the summer months. No endangered or threatened fish species are known to exist in the basin. Species composition and relative numbers were provided in the August 19, 1980 Planning Aid Letter.

Future conditions without the project were assumed to remain status quo; therefore, the data collected for the purpose of defining existing conditions will also apply to conditions in the future without the project.

The monthly median hydrograph (Table 4) was used to represent the normal or ordinary amount of water historically found in the river.

Table 4. Monthly Median Hydrograph, South Sulphur River at Cooper, Texas, USGS 07342500

Flow in Cubic Feet Per Second

	Month											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Discharge	19	30	31	19	31	12	1	0.1	0.3	1.1	5	13

This quantity of water, after being modelled by PHABSIM, determined the quantity and quality of existing habitat based on the assumption that streamflow is the factor limiting aquatic productivity in the study area. Output from the WSP program was translated into surface acres of stream habitat and presented in Table 5. These acreages will be used in a comparative impact analysis of project alternatives in the next section of this report.

Table 3. Life History Table

SPECIES	LIFE HISTORY STAGE	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
gizzard shad	spawning			X	X								
	fry				X	X							
	juvenile					X	X	X	X	X	X	X	X
	adult	X	X								X	X	X
carp	spawning			X	X								
	fry				X	X							
	juvenile					X	X	X	X	X			
	adult	X	X						X	X	X	X	X
channel catfish	spawning					X	X						
	fry						X	X					
	juvenile							X	X	X	X		
	adult	X	X	X	X					X	X	X	X
white bass	spawning			X	X								
	fry				X	X							
	juvenile					X	X	X	X	X			
	adult	X	X							X	X	X	X
spotted bass	spawning				X	X							
	fry					X	X						
	juvenile						X	X	X	X	X		
	adult	X	X	X						X	X	X	X
largemouth bass	spawning			X	X								
	fry				X	X							
	juvenile					X	X	X	X	X			
	adult	X	X						X	X	X	X	X
green sunfish	spawning					X	X						
	fry						X	X					
	juvenile							X	X	X	X		
	adult	X	X	X	X					X	X	X	X
bluegill	spawning					X	X						
	fry						X	X					
	juvenile							X	X	X	X		
	adult	X	X	X	X					X	X	X	X
white crappie	spawning				X	X							
	fry					X	X						
	juvenile						X	X	X	X	X		
	adult	X	X	X						X	X	X	X
freshwater drum	spawning				X	X							
	fry 1/					X	X						
	juvenile						X	X	X	X	X		
	adult	X	X	X						X	X	X	X

1/ data unavailable for evaluation

Table 5

Acreages by Stream Segment for Existing Conditions
Cooper Lake and Channels Project, Texas

Segment	Discharge1/	Length2/	Area3/	Acres/mile	Total Acres
1	1	1.0	12,743	1.54	1.54
2	5	0.6	19,039	2.30	3.80
3	5	0.6	19,039	2.30	3.80
4	3	1.5	17,746	2.15	3.22
5	1	1.4	19,039	2.30	3.22
6	3	0.5	13,924	1.68	0.84
7	3	2.3	15,207	1.84	4.23
8	6	4.3	16,167	1.95	8.38
9	14	15.4	27,676	3.35	51.59
10	1	3.4	12,743	1.54	5.23
11	1	5.5	12,743	1.54	8.47
12	1	7.8	12,743	1.54	12.01
SUBTOTALS		44.3			106.33
13	14	14.5	27,676	3.35	45.58
14	14	0.5	36,480	4.42	2.21
15	38	8.7	35,087	4.25	36.98
16	50	3.6	35,179	4.26	15.34
17	50	9.7	24,847	3.01	29.20
18	83	76.2	53,572	6.49	494.54
SUBTOTALS		113.2			626.85
TOTALS		157.5			733.18

1/ Average of the monthly median discharges in cubic feet per second.
2/ Miles of stream.
3/ Square feet per 1,000 linear feet
of stream at the discharge in Column 2.

Future with the Project

The evaluation of project alternatives (Table 6) was based on a breakdown of the stream segments pertaining to that alternative.

Table 6. Project Alternatives Analyzed in the Aquatic Evaluation

I. Plan Recommended in the FES

A. Segments 1-18 identify existing conditions
B. Segments 1-12 identify stream to be inundated by lake
C. Segments 13-18 identify the mitigation potentials of downstream operational releases.

II. Cooper Lake with Flood Control, No New Channels or Levees (Plan Recommended in SES)

A. Segments 1-18 identify existing conditions
B. Segments 1-12 identify stream to be inundated by lake
C. Segments 13-18 identify the mitigation potentials of downstream operational releases.

III. Cooper Lake Without Flood Control

A. Segments 1-18 identify existing conditions
B. Segments 1-12 identify stream to be inundated by lake
C. Segments 13-18 identify the mitigation potentials of downstream operational releases.

IV. Non-structural - Status Quo - Segments 1-18.

The effects of the 7.5 miles of the proposed channel work, outlined in alternative I, could not be assessed due to insufficient biological data. The deletion of this analysis makes the stream impacts of the structural alternatives similar; therefore, the results of the aquatic evaluation applies to all three structural alternatives.

A more detailed presentation of the aquatic assessment may be found in the Planning Aid Letter dated August 19, 1980. Consequently, the results will only be summarized in this report.

Output from the HABTAT, which is expressed in "habitat units" (HU), was the data source used in quantifying project impacts and designing a mitigation plan. HU are defined as the quantity of a given habitat times its quality. All of the HU were totaled for the stream segments to be inundated (Segments 1-12) and listed as a loss. The HU were also totaled for the remaining portion of the Sulphur River downstream from the proposed reservoir. This latter figure served as a base upon which HU could be added or subtracted through the design of an operational release schedule.

As flow was increased above the existing conditions regime, HU oftentimes decreased for selected life history stages, particularly those

stages which prefer slack water. For an example, the fry of any of the evaluation species generally prefer shallow, slow-moving water. Streams suffering from a lack of flow during the midsummer months, when the fry of most species are prevalent, provide such conditions. This shallow, slow moving water is generally not suitable as adult habitat; therefore, this surplus in fry habitat and shortage in adult habitat are adjusted through discharge manipulation and management. Table 7 lists four discharge schedules, expressed in cubic feet per second, which were analyzed for mitigatory potential. Also depicted are the historical monthly average and median hydrographs.

Table 7. Hydrograph Presentation

	Months												
Flow Schedule (cfs)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVG
#1	45	45	50	50	30	30	30	30	45	45	45	45	41
#2	35	35	40	40	20	20	20	20	35	35	35	35	31
#3	25	35	35	25	20	15	10	10	25	25	25	25	23
#4	5	5	5	5	5	5	5	5	5	5	5	5	5
Historical Average	300	625	516	739	834	464	95	31	226	276	406	434	415
Historical Median	19	30	31	19	31	12	1	0.1	0.3	1.1	5.0	13.0	13.5

Flow schedule number one is the optimum flow for the total fishery. Within the confines of the river channel, increases in flow will only increase HU to a certain (optimal) level; higher flows become detrimental to the fishery. This optimal flow was determined in an analysis of the HABTAT output. Flow schedules two and three are graduated reductions from the optimum which could be implemented during periods of drought. Flow schedule number four was proposed by the Corps (Recommended Plan in the FES) as their mitigation flow. The historical monthly average flows represent the amount of water available in the system, and the historical monthly median flows, as mentioned earlier, quantify and qualify stream habitat under existing conditions in the downstream area. Percent compensation was determined for each flow schedule by correlating HU with surface acres of stream habitat as flow was varied. Table 8 displays the number of acres of aquatic habitat associated with each schedule.

Table 8

Reservoir Operational Alternatives
Cooper Lake and Channels Project, Texas

Alternative	Segment	Discharge[1/]	Length[2/]	Area[3/]	Acre/mile	Total Acres
Recommended Plan	13	41	14.5	30,987	3.76	54.52
(Flow Schedule #1)	14	41	0.5	41,991	5.09	2.55
listed in Table 7	15	65	8.7	36,699	4.45	38.70
	16	77	3.6	37,263	4.52	16.27
	17	77	9.7	27,376	3.32	32.20
	18	110	76.2	56,576	6.86	522.73
					TOTAL	666.97
Contingency #1	13	31	14.5	30,020	3.64	52.76
(Flow Schedule #2)	14	31	0.5	41,394	5.02	2.51
listed in Table 7	15	55	8.7	35,994	4.36	37.96
	16	67	3.6	36,307	4.40	15.84
	17	67	9.7	26,150	3.17	30.75
	18	100	76.2	55,523	6.73	512.83
					TOTAL	652.65
Contingency #2	13	24	14.5	28.546	3.46	50.20
(Flow Schedule #3)	14	24	0.5	39,425	4.78	2.39
listed in Table 7	15	47	8.7	35,883	4.35	37.84
	16	59	3.6	36,035	4.37	15.72
	17	59	9.7	25,902	3.14	30.45
	18	92	76.2	54,530	6.61	503.66
					TOTAL	640.26
Corps' Plan	13	5	14.5	24,589	2.98	43.21
(Flow Schedule #4)	14	5	0.5	19,646	2.38	1.19
listed in Table 7	15	29	8.7	35,079	4.25	36.99
	16	41	3.6	35,207	4.27	15.36
	17	41	9.7	24,560	2.98	28.88
	18	74	76.2	53,700	6.51	495.99
					TOTAL	621.62

1/ Average of the monthly median discharges in cubic feet per second.

2/ Miles of Stream

3/ Square feet per 1,000 linear feet of stream at the discharge in column 2.

The upstream area was determined to be of a lesser quality than the downstream area because of an overall decrease in the probabilities of use for the existing velocity and depth combinations. A surface acre gained downstream, offset more than one surface acre lost upstream. Therefore, an adjustment factor was used to reflect this difference. The adjustment factor was calculated by dividing the HU per surface acre upstream into the HU per surface acre downstream. This process permitted a comparison of the qualitative components of the two areas. Percent compensation was subsequently calculated by dividing the total number of surface acres lost upstream into the total number of surface acres gained downstream (including the adjustment). Table 9 presents the percent compensation realized by each plan.

Table 9

Stream Compensation Analysis Related To Existing Conditions

	Total Acres (from Table 8)	Acres Created	Acres Adjusted 1/	Compensation 2/
FWS Recommended Mitigation Plan	667	40	48	45%
Contingency Plan #1	653	26	31	29%
Contingency Plan #2	639	13	16	15%
CE Plan (5 cfs only)	622	-5	-6	-6%

1/ The acres created were multiplied by the adjustment factor 1.21 to account for the qualitative difference between the stream area to be inundated and the management reach.

2/ Percent compensation is defined as the acres adjusted divided by the acres lost times 100 (In table 14, segments 1-12 identified 106.33 acres lost due to inundation).

TERRESTRIAL RESOURCES

Future Without the Project

Previous FWS reports contain descriptions of the area of fish and wildlife resources and the habitats which support them. In addition, the appendices contained in the FES and issued by the New Orleans, Louisiana District CE contained check lists of the Sulphur River Basin's flora and fauna.

These appendices reveal there are numerous algae; several hundred species of invertebrates; 108 tree, shrub, and vine species; 40 herbaceous plant

species; 32 species of mosses; 83 species of reptiles and amphibians 306 avian species; 42 species of mammals and 83 fish species in the Sulphur River Basin. It is probable that not all species of flora and fauna in the basin have been identified. From the species list, it is apparent that considerable biological variety exists in the area.

The area potentially affected by alternatives under study in this report is known habitat or former habitat of a number of species of fauna listed as endangered by the FWS (Federal Register, 16 January 1979). Wandering or migrating bald eagles, Haliaeetus leucocephalus, are occasionally sighted; however, no known active or recently active nests have been identified. Similarly, the Arctic peregrine falcon, Falco peregrinus tundrius, also may migrate through the area enroute to wintering areas along the Texas Coast. The range of the American alligator, Alligator mississippiensis, extends into the lower Sulphur River Basin. The Arkansas Game and Fish Commission manages a population of alligators on the Sulphur River Wildlife Management Area in Miller County, Arkansas.

There are no known endangered species of invertebrates or flora in this area, however, nine Champion Trees (Table 10) are found in the central and eastern portions of the basin.

Table 10. Texas Champion Big Trees in Counties of the Sulphur River Basin, Texas

Common Name	Scientific Name	County Located
Black locust	Robina pseudo-acacia	Titus
Silver maple	Acer saccharinum	Bowie
Wax myrtle	Myrica cerifera	Morris
Blackjack oak	Quercus marilandica	Titus
Osage orange	Maclura pomifera	Bowie
Shortleaf pine*	Pinus echinata	Morris
Sassafras	Sassafras albidum	Cass
Sweetgum	Liquidambar styraciflua	Morris
American chestnut	Castanea dentata	Red River
Pear	Pyrus communis	Cass

*National Champion

The areas of project influence are (1) the lands to be inundated by the reservoir, (2) the adjoining project lands, and (3) the downstream flood plain which would receive protection from the project's flood control features. Future conditions without the project are assumed to remain status quo.

Three habitat types, bottomland hardwoods (BLHW), semiwooded (SW), and openland (OL), were selected for use [illegible] the FWS's Habitat Evaluation

Procedures. Evaluation species or elements were chosen to represent each habitat type. Each habitat type was subsequently rated, based on the habitat's ability to provide key life requisites, such as food, cover, and water, for each species. These qualitative rating figures (on a scale of 0-100) or habitat unit values (HUV) are displayed in Table 11.

Table 11

Habitat Evaluation Element Value by Habitat Type
Cooper Lake and Channels Project, Texas

	Habitat Type and Unit Value		
Evaluation Element	Bottomland Hardwood	Semiwooded Land	Open Land
Three-toed Box Turtle	73	43	30
Red Shouldered Hawk	71	48	29
Yellow-crowned Night Herom	70	--	--
Wood Duck	64	--	--
Bobwhite Quail	--	54	48
Cotton Rat	--	49	47
Raccoon	72	46	35
Gray Squirrel	56	--	--
White-tailed Deer	67	51	9
Bobcat	71	49	--
Average Habitat Unit Value	68.0	48.5	33.0
Number of Sites Sampled	7	6	6

--Not used in analysis for the indicated habitat type.

An analysis of existing conditions would not be complete without mentioning the impacts already incurred under the authorized project prior to enjoinment. Because of past work, primarily stream channelization and levee construction for flood control which resulted in significant land use changes, a considerable amount of losses to terrestrial wildlife habitat has already occurred. Compensation requirements for such losses would result in the purchase of 40,706 acres of BLHW and 25,332 acres of SW habitat to be managed to a HUV of 90.0.

Future With the Project

All four alternatives were evaluated for impact to terrestrial habitat on the basis of habitat value and the area impacted. Once the value for each habitat type was determined, this value was multiplied by the acres

of habitat to be gained or lost at specific target years over the life of the project (100 years). These values were subsequently annualized.

The terrestrial habitat inundated by each reservoir alternative will be totally destroyed, while other lands will be changed from one habitat type to another. As an example of this latter point, those BLHW which receive flood protection as a result of the project, will probably be cleared for intensive agricultural use. Additionally, OL and SW habitats acquired as part of the project will probably revert to forest lands within the life of the project.

In order to address these changes in habitat over the life of the project, the curves in Figures 1, 2, and 3 were drawn to reflect the time required (with management) for each evaluation criterion to reach its optimum habitat unit value. The area under each curve became the basis upon which habitat impacts and mitigation requirements were quantified over time. The data used in developing the curves were obtained through a literature review. These data have been placed on file in the Fort Worth Field Office.

In developing a mitigation plan or identifying compensation needs, the ability to manipulate or manage habitat is invaluable. Examples of such manipulation include the development of optimum food, water, and cover sources (see Figures 4-6). Allowing natural plant succession to proceed on certain habitat types (permitting existing plant communities to progress to some higher plant community) and imposing management techniques on others (intentionally reverting a higher plant community) have long been recognized as beneficial habitat management tools. Additionally, the rate of succession can be altered by introducing such practices as planting seeds, setting trees, and/or discing to encourage forb growth. As mentioned earlier, the results of such management are quantified through the use of the optimum habitat curves.

Table 12 displays the acre equivalents of the three analyzed habitats when one type is converted into another and subjected to management.

Table 12

Acre Equivalents for Bottomland Hardwood and Semiwooded Habitats Relative to 1,000 Acres of Open Land Habitat

	Habitat Unit Value		
Habitat Type	80	90	100
BLHW	600	675	750
SW	680	765	850

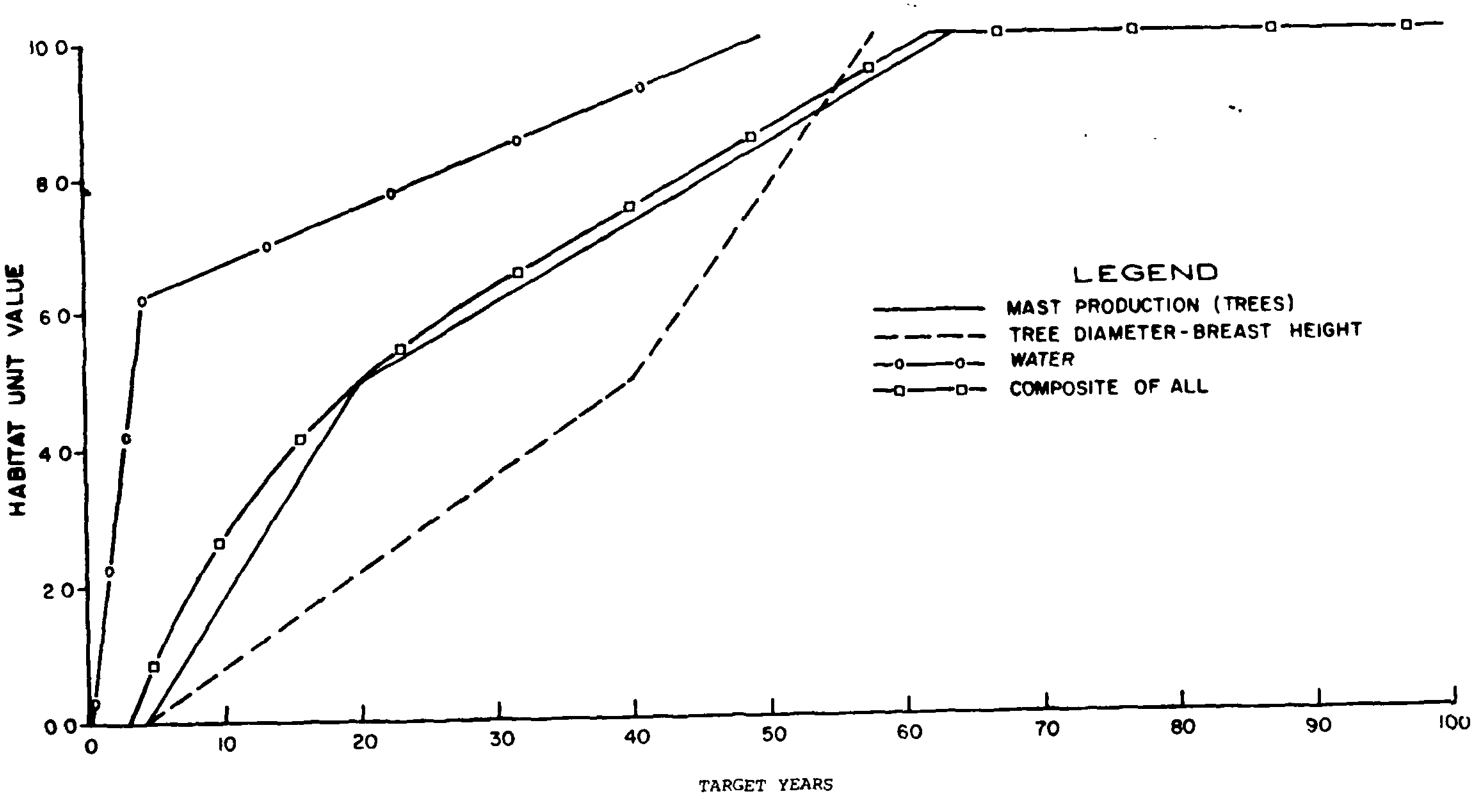


Figure 1. Change in Habitat Unit Values with Management Over the Life of the Project for Bottomland Hardwoods

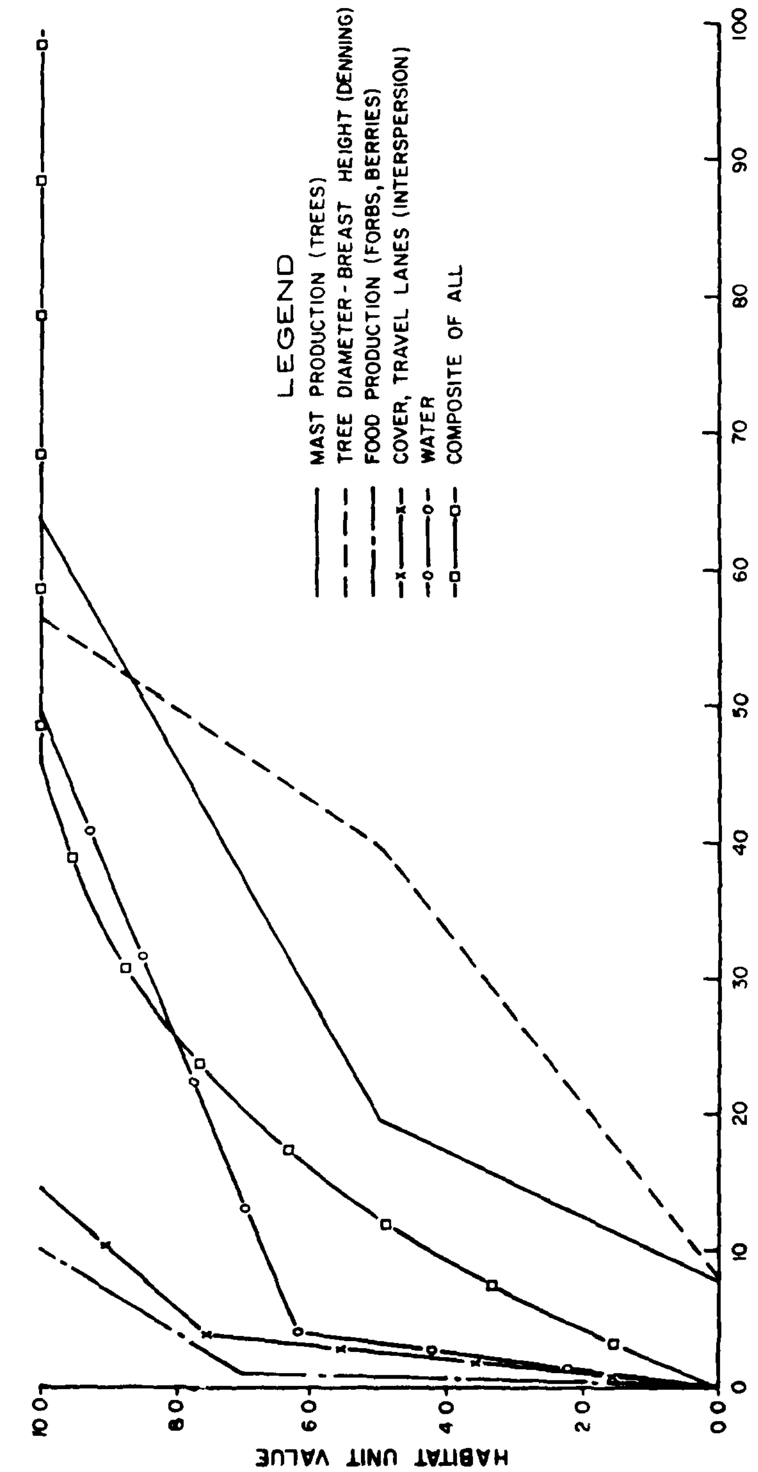


Figure 2. Change in Habitat Unit Values with Management Over the Life of the Project for Semiwooded Habitat.

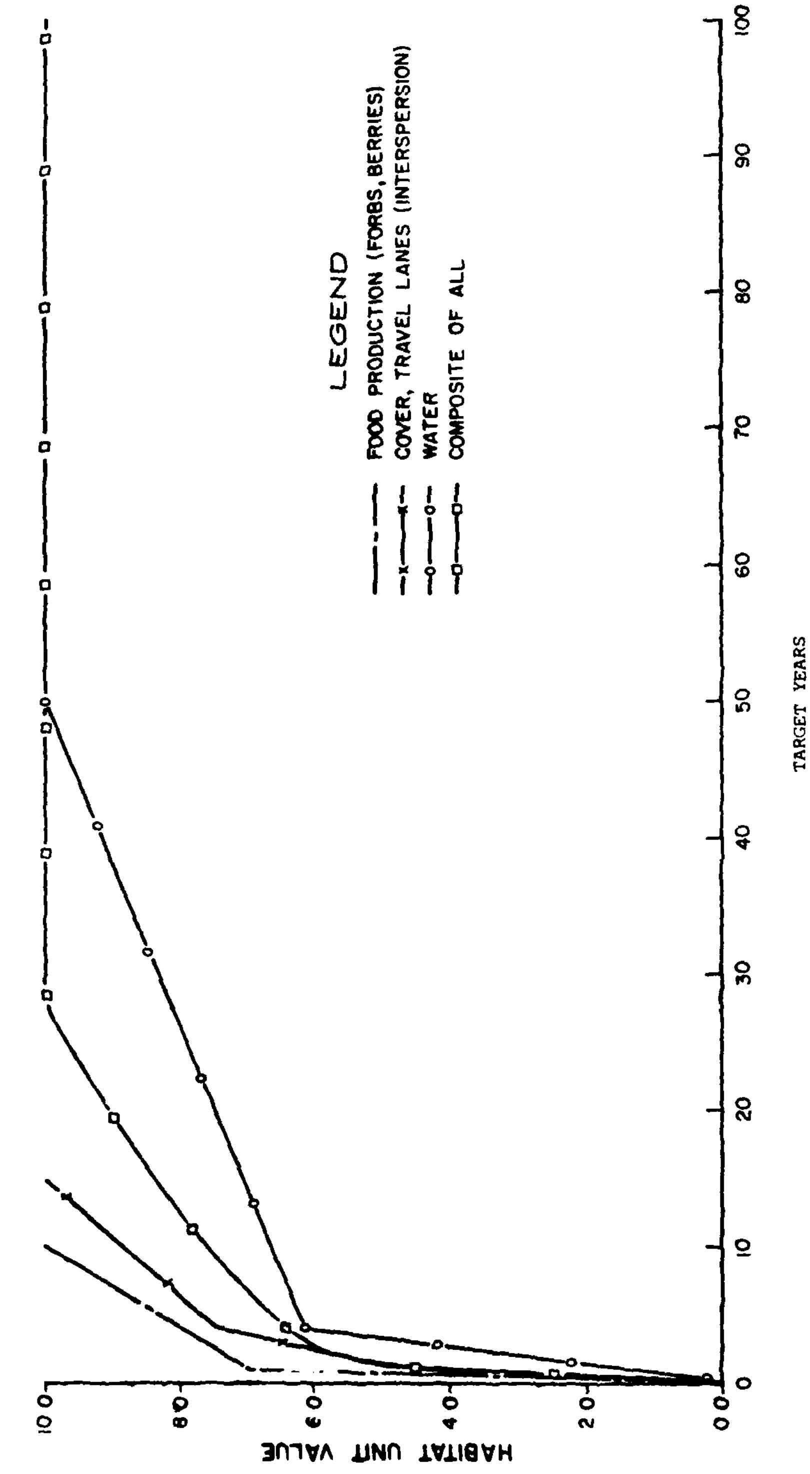
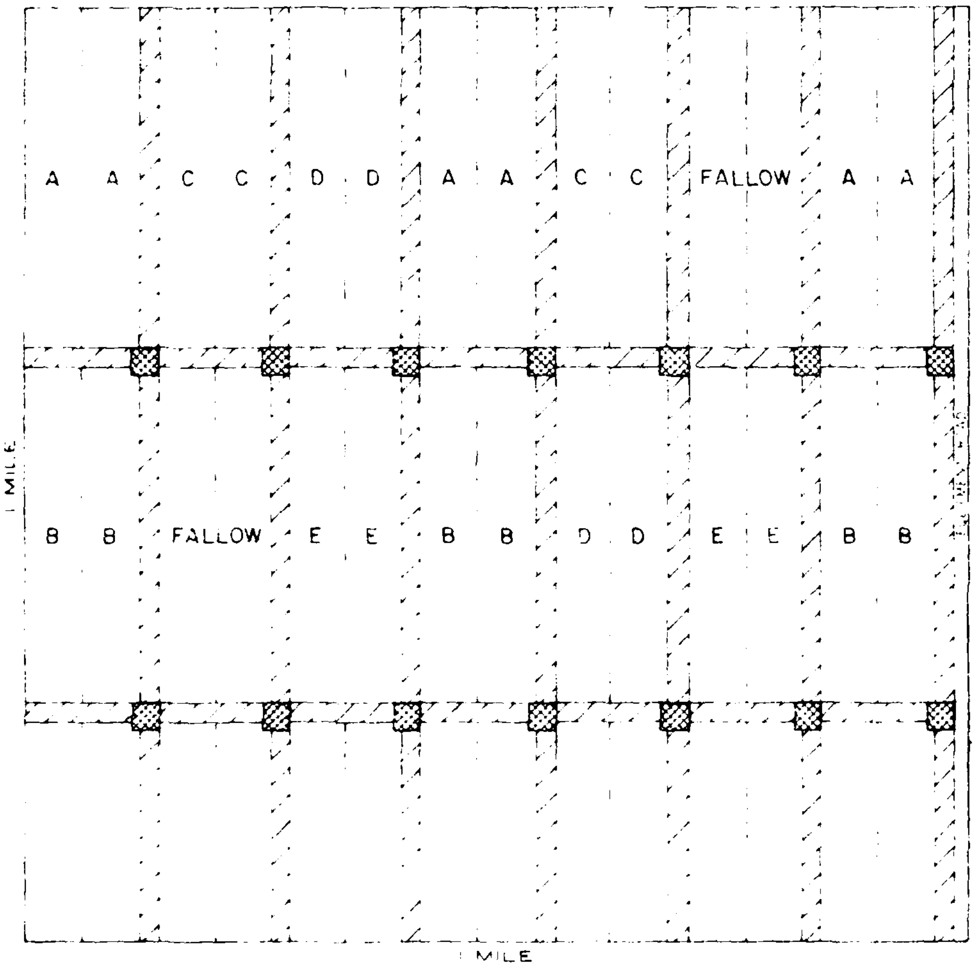


Figure 3. Change in Habitat Unit Values with Management Over the Life of the Project for Openland Habitat.

Figure 4.

HABITAT MANAGEMENT OVERLAY
TO BE USED ON SEMIWOODED AND
OPENLAND HABITATS
COOPER LAKE AND CHANNELS PROJECT,
TEXAS



LEGEND

	BRUSHY TRAVEL LANE (104 FEET WIDE)
	WOODY MOTT (156 FEET SQUARE)
A	SMALL GRAIN
B	SMALL GRAIN
C	SMALL GRAIN
D	SMALL GRAIN
E	SMALL GRAIN
— — —	UNHARVESTED STRIP (10 FEET WIDE)

Figure 5.

HABITAT MANAGEMENT OVERLAY
TO BE USED ON BOTTOMLAND HARDWOOD
SEMIWOODED, AND OPENLAND HABITATS
COOPER LAKE AND CHANNELS PROJECT,
TEXAS

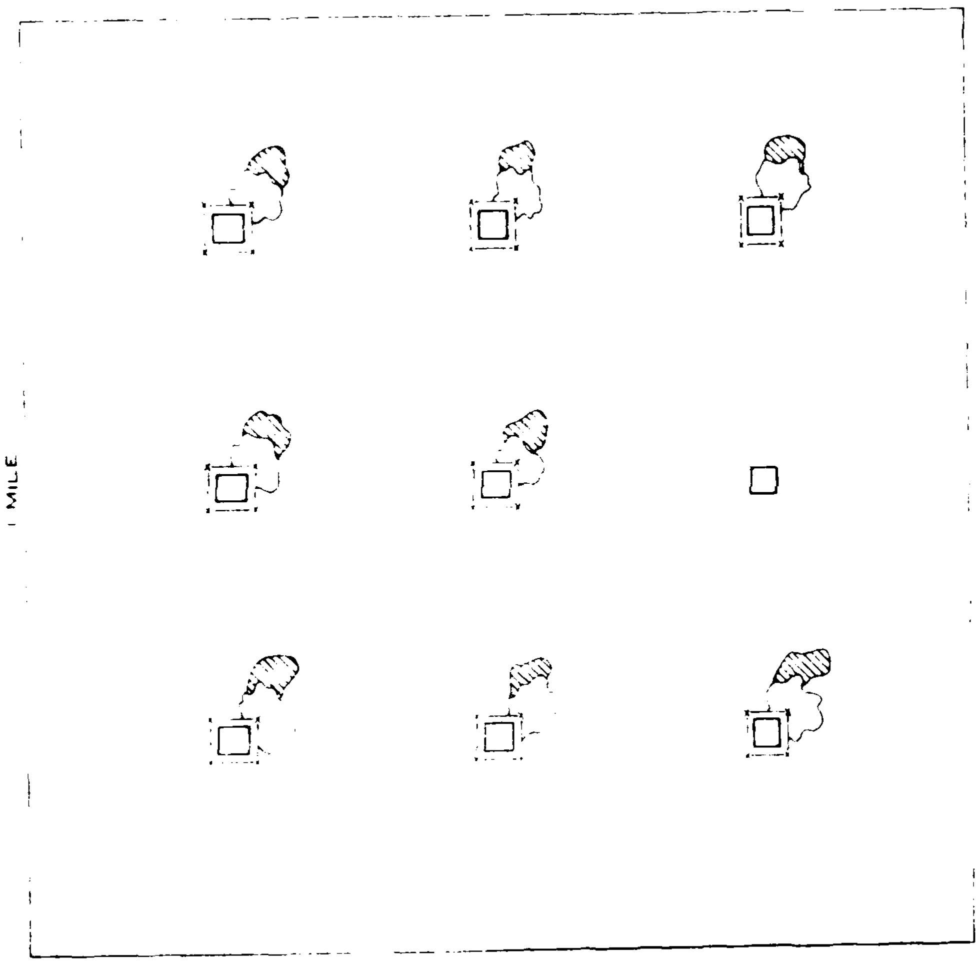
LEGEND

FENCE

POND (0.5 ACRE)

CLEARING (1.0 ACRE)

DEBRIS FROM CLEARING



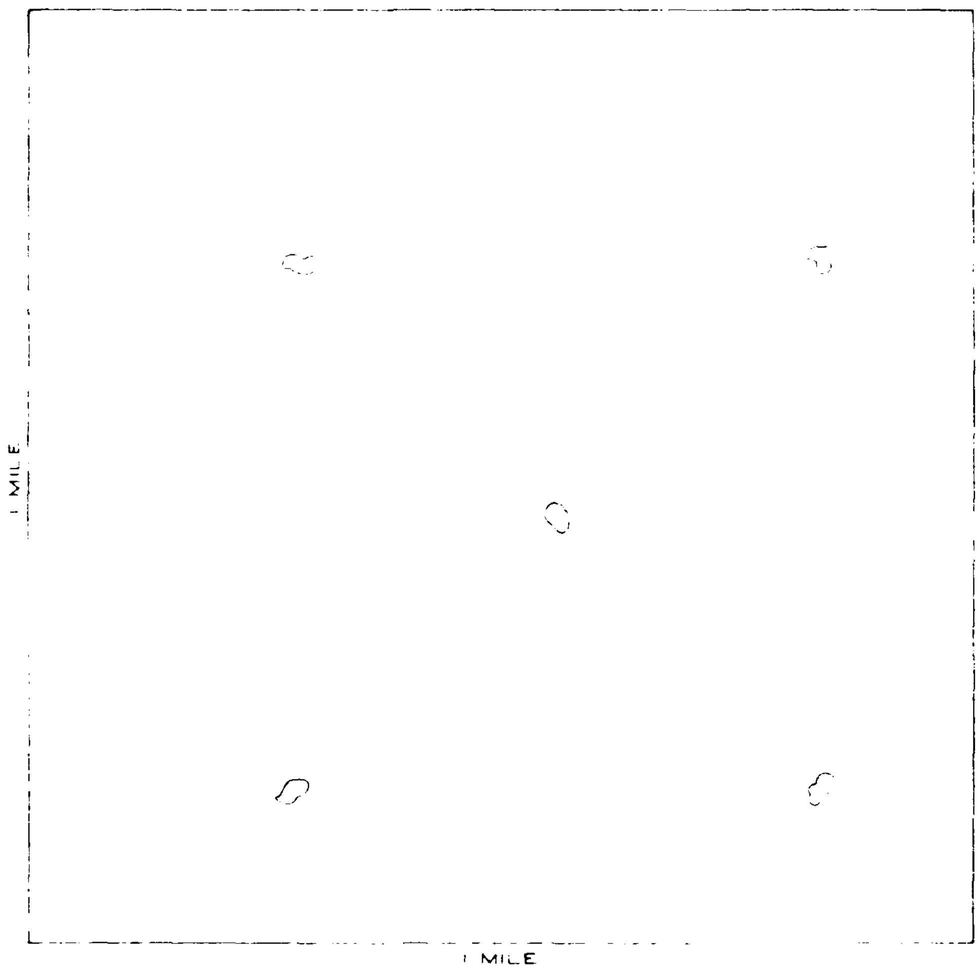


Figure 6.

HABITAT MANAGEMENT OVERLAY
TO BE USED ON SEMIWOODED AND
OPENLAND HABITAT
COOPER LAKE AND CHANNELS PROJECT,
TEXAS

LEGEND

GROUND DENNING AREAS MADE FROM BRUSH/LOGS AND/OR PILED-UP EARTH AT SPATIAL SCALE INDICATED. ACTUAL SIZE NOT TO SCALE

Table 13
Habitat Type in Acres, Potentially Affected by Project Alternative and Component
Cooper Lake and Channels Project, Texas

Project Component	Plan Recommended in FES			Cooper Lake With Flood Control, No New Channels or Levees (Currently Recommended Plan)			Cooper Lake Without Flood Control			Nonstructural		
	BLHW:	SW:	OL:	BLHW:	SW:	OL:	BLHW:	SW:	OL:	BLHW:	SW:	OL:
Water Supply Pool	5,905	5,800	7,600	5,905	5,800	7,600	5,905	5,800	7,600	-	-	-
Perimeter Clearing	291	112	717	291	112	717	291	112	717	-	-	-
Flood Control Pool	602	232	1,481	602	232	1,481	-	-	-	-	-	-
Damsite and Spillways	55	155	200	55	155	200	55	155	200	-	-	-
Dam Borrow Areas	150	145	190	150	145	190	150	145	190	-	-	-
Outlet Channel	8	7	10	8	7	10	8	7	10	-	-	-
Recreation Areas	858	330	2,112	858	330	2,112	-	-	-	24,200	-	-
Fee Take Line	790	304	1,946	790	304	1,946	195	75	460	-	-	-
Total, Habitat	8,659	7,085	14,256	8,659	7,985	14,256	6,604	6,294	9,177	24,200		
Total, Project		30,000			30,000			22,075			24,200	
Levees & Channels												
Total, Habitat	600	85	115	-	-	-	-	-	-	-	-	-
Total, R.O.W.		800			-			-			-	
Downstream Res. Flood Protection	3,200	1,500	8,200	3,200	1,500	8,200	-	-	-	-	-	-
Downstream L&C Flood Protection	8,700	1,800	900	-	-	-	-	-	-	-	-	-
3 Year Flood Plain (Voluntary Land Use)	-	-	-	-	-	-	-	-	-	56,300	6,600	3,300
3-30 Year Flood Plain (Voluntary Land Use)	-	-	-	-	-	-	-	-	-	3,200	3,000	12,900
Total, Habitat	11,900	3,300	9,100	3,200	1,500	8,200	-	-	-	59,500 1/	9,600	16,200
Total, Protected Area		24,300			12,900						85,300	

1/ Includes 24,200 acre recreation corridor.

Table 14

Acres of Land Required for Compensation at Indicated Habitat Unit Value Level by Habitat Type for Alternative Plans, Cooper Lake and Channels Project, Texas.

Project Alternatives1/

Habitat Type HUV Level	Plan Recommended in FES	Cooper Lake Without Flood Control (Water Supply Only)	Cooper Lake With Flood Control, No New Channels or Levees (currently recommended plan)	Nonstructural
Bottomland Hardwoods1/				
HUV 80	79,613	34,575	37,251	
HUV 90	45,788	19,885	21,424	11,400 4/
HUV 100	32,489	14,110	15,202	
Semiwooded1/				
HUV 80	13,395	9,475	10,255	17,562
HUV 90	10,919	7,723	8,359	14,316
HUV 100	8,900	5,884	6,814	11,668
Openland				
HUV 80		4,441		
HUV 90	4,802 2/	3,925	4,003 3/	300 2/
HUV 100		3,369		

1/ Openland Habitat Type Surpluses have been credited to Bottomland Hardwoods and Semiwooded Habitat Types where appropriate.

2/ HUV Level inappropriate. Number is acres of Increased Openland Habitat with Project.

3/ HUV Level inappropriate. Number is acres of Decreased Openland Habitat with Project.

4/ HUV Level inappropriate. Number is acres of Increased Bottomland Hardwood Habitat with Project.

The number of acres of each habitat type, potentially affected by the four project alternatives, is shown in Table 13. Compensation requirements, corresponding to the listings in Table 8, are found in Table 14.

Habitats of equal quality to that being destroyed were identified during the mitigation analysis. Based on the assumption that these lands could be managed to a habitat unit value of 90.0, the size and location of two mitigation areas (one proposed by the FWS, the other by the CE) were designated for the plan recommended in the Draft SES (See Plates 2-A through 2-D). The pertinent acreage and percent compensation data are presented in Table 15 for both plans. This area includes land adjoining the upper end of Wright Patman Lake and extends upstream into the White Oak Creek drainage to a point south of Talco, Texas.

An alternative compensation plan replaced the portion along White Oak Creek with lands bordering the Sulphur River mainstem upstream to an area south of Boxelder, Texas; however, the habitat was considered to be less desirable. Acreage measurements for this latter tract, including the Wright Patman area, reflected 19,100 acres of BLHW, 6,800 acres of SW, and 6,200 acres of OL, a total of 32,100 acres. Since the impacts associated with the plan recommended in the FES would be more extensive, the amount of land required for mitigation would also be greater. Therefore, in conjunction with the Wright Patman lands, both of the previously mentioned tracts would be required. The totals by habitat type would be 41,800 acres of BLHW, 13,100 acres of SW, and 10,600 acres of OL, a total of 65,500 acres.

Table 15

Acres Required 1/ for Compensation, FWS Recommended Acres, CE Recommended Acres and Percent Compensation by Habitat Type and Total, Currently Recommended Plan, Cooper Lake and Channels Project, Texas

Habitat Type	Required acres	FWS Recommended acres	FWS %	CE Recommended acres	CE %
BLHW	21,424	22,700	106	21,051	93
SW	8,424	6,300	100 2/	5,200 3/	82
OL	0	4,400	--- 2/	0 3/	--
Total	29,773	33,400	112	26,251	88

1/ At an assumed 90.0 HUV annualized over project life.
2/ OL would convert to SW over project life.
3/ OL and SW combined.

For the Cooper Lake Without Flood Control alternative, compensation requirements for BLHW and SW habitat are slightly less than the require-

ments for the plan recommended in the Draft SES. The Cooper Lake Without Flood Control plan does, however, have a net adverse impact on OL habitat, whereas the Draft SES proposed plan did not. Either of the previously described compensation areas should adequately offset terrestrial habitat losses due to implementation of this plan.

The Non-structural Plan which was presented in the Draft SES only impacts SW habitat, primarily due to the succession of SW to BLHW. Since the BLHW are of a higher quality and are more productive than the SW habitat, the FWS would agree to this alteration.

HUMAN USE AND MONETARY ANALYSIS

The Cooper Lake and Channels study area was limited to the nine county area which comprise Region 13 of the 1975 Texas Outdoor Recreation Plan (TORP) compiled by TPWD. The study area included Bowie, Cass, Delta, Franklin, Lamar, Hopkins, Morris, Red River, and Titus counties of Texas. Origins of recreational demand and trends in rates of sport hunting and fishing recreation were obtained from the 1975 TORP and from the draft 1980 TORP. Projected populations for the counties which contribute to the recreational demand in the economic study area were obtained from the Corps of Engineers.

Aquatic

The evaluation of existing and future sport and commercial fishing resources were limited to large reservoirs and free-flowing streams and rivers. Demands for sport fishing opportunities, however, were estimated for several water types as indicated in Table 16.

Table 16. Estimated Sport Fishing Demand by Water Type For Cooper Lake and Channels Nine County Planning Area (In Thousands of User-Days)

	Planning Year						
	1990	2000	2010	2020	2030	2040	2089
IMPOUNDMENTS							
Less than 10 acres	369	445	499	556	620	687	687
Greater than 10, less than 250 acres	834	1008	1131	1261	1405	1558	1558
Greater than 250 acres	549	661	742	826	921	1021	1021
FREE-FLOWING STREAMS	312	375	421	469	523	580	580

An estimate of the number of miles of fishable streams within the economic study area was obtained by measuring the streams identified in the "Stream Evaluation Map of Texas", 1978. Stream segments which formed county or State boundaries were equally divided between adjacent counties or States to prevent over estimation of stream fishing opportunities. Miles of fishable streams are shown in Table 17.

Table 17. Miles of Fishable Streams, Cooper Lake and Channels
Nine County Study Area

County	Miles of Fishable Streams
Bowie	209.8 1/
Cass	109.0
Delta	85.9
Franklin	37.9
Hopkins	76.7
Lamar	166.6 1/
Morris	29.2
Red River	179.4 1/
Titus	67.8
TOTAL	962.3

1/ Includes ½ of the mileage of the Red River which closely approximates the Texas-Oklahoma Boundary

Various streams within the Northeast Texas area have been estimated to be able to provide from 10 to 20 user-days of sport fishing per acre per year. Most of these streams average less than 15 feet in width. The major rivers such as the Sulphur and Red River are considerably larger; however, for purposes of illustrating the need for stream fishing opportunities within the study area, stream sport fishing potential was over estimated based on a normal stream width of 40 feet and 20 user-days per acre. This indicates that only 93,300 user-days are available within the study area compared to immediate needs of over 300,000 user-days and projected needs to approach 600,000 user-days during the period of analysis.

The existing lake sport fishing opportunities were estimated to be 404,650 man-days based upon a reported 40,465 surface acres of lakes existing within the economic study area (TORP 1980) and an estimated average potential of 10 man-days of sport fishing per surface acre per year for lakes in the Sulphur River drainage (National Reservoir Research Program, USFWS).

Future conditions without the influence of a federal project have been assumed to remain unchanged. Therefore, the potential supplies illustrated in the tables for existing fisheries resources constitute the future without project condition.

The assumption was made, based on the demands analysis for the entire study area, that demands within the Sulphur River Basin were equal to or greater than existing supplies. Consequently, all losses to stream fisheries, both sport and commercial, were charged to the project. Gains attributed to implementation of the reservoir alternatives take into consideration the projected needs for reservoir sport fishing within the entire study area. All gains and losses indicated in Table 18 reflect an interest rate of 3¼% over the 100 year period of analysis.

Table 18. Potential Gains and Losses of User-Days of Sport Fishing and Returns to Commercial Fishermen, Cooper Lake and Channels

	STREAM		RESERVOIR 1/	
	Sport 2/	Comml. 3/	Sport	Comml.
Existing and Future Without	17,297	6,486	0	0
With Reservoir and Corps' Release Plan (5 cfs only)	15,043	5,641	192,202	9,708
Gains/losses	- 2,254	- 845	+192,202	+9,708
With Reservoir and FWS Release Fish	16,141	6,053	192,202	9,708
Gains/losses	- 1,156	- 433	+192,202	+9,708

1/ Reservoir based on water supply pool and is applicable to multipurpose and water supply only alternatives. Effects of adding levees or new channels were not evaluated in the aquatic analysis and therefore cannot be evaluated in the economic analysis.

2/ In user-days.

3/ In dollars based on 1974 value of $0.15/lb. average for commercial food and non-food fish.

Terrestrial

The estimated sport hunting demand by target year is depicted in Table 19. Over the life of the project, the greatest demand in user-days is for squirrel. White-tailed deer, dove, rabbit and quail are also projected to remain in high demand by the sport hunter.

Table 19. Estimated Sport Hunting Demand by Species for Cooper Lake and Channels Nine County Planning Area (In Thousands of User-days)

	Planning Year						
Species	1990	2000	2010	2020	2030	2040	2089
White-tailed deer	102	128	150	175	197	215	215
Turkey	4	5	6	7	8	9	9
Squirrel	118	147	173	202	227	247	247
Rabbit	54	68	79	93	104	114	114
Dove	68	85	99	116	131	142	142
Quail	45	57	66	77	87	95	95
Raccoon	0.8	1.0	1.1	1.4	1.6	1.7	1.7
Coyote	12	15	18	20	23	25	25
Fox	8	10	12	14	15	17	17

Geographical coordinates for each county in the study area were provided to the TPWD. From this data, the TPWD extracted vegetation type data from the Paris and Longview LANDSAT scenes which have recently been classified for the development of Texas vegetation type maps. The vegetation data was combined and adjusted to reflect the acreages of bottomland hardwoods, semiwooded area, and openland within each county. This data is presented in Table 20.

Table 20. Terrestrial Habitat Types by County, Cooper Lake and Channels Study Area (In Thousands of Acres)

	Habitat Type		
County	Bottomland Hardwoods	Semiwooded	Openland
Bowie	85	229	234
Cass	115	348	124
Delta	24	11	126
Franklin	46	41	85
Hopkins	104	55	305
Lamar	83	81	351
Morris	27	62	72
Red River	135	207	288
Titus	38	76	148

Potential user-day supplies for sport hunting were calculated using nine evaluation elements composed of twelve species. These estimates are based on wildlife inventory, harvest rates, and hunter success data provided by a TPWD wildlife biologist familiar with the study area. Sport hunting supply by evaluation element is shown in Table 21.

Table 21. Estimated Sport Hunting Supply in the Nine County Cooper Lake and Channels Study Area (In Thousands of User-Days)

Evaluation Element	Supply
White-tailed deer	100
Turkey	trace
Squirrel1/	413
Rabbit2/	193
Dove	17
Quail	61
Raccoon	53
Coyote	59
Fox3/	26

1/ Fox and gray
2/ Cottontail and swamp
3/ Red and gray

While it is recognized that changes in land use, and therefore quality of habitat, will occur at specific locations, the overall land use has been assumed to remain unchanged. Therefore, the future without project conditions for the terrestrial analysis has been determined to be the same as under existing conditions.

The impacts displayed in Table 22 are indicative of the potential loss or gains in man-days for sport hunting without regard to the projected demands of the nine county study area. Comparison of demand and supply indicate that needs will exist for white-tailed deer, quail and turkey within a short period of time. Demand for other species evaluated is not projected to approach the projected supplies of these species during the life of the project. However, existing data allowed prediction of anticipated demand only to the county level. Although the level of demand was unquantifiable for the specific areas influenced by the project alternatives, we believe that within the study area a majority of actual hunting demand occurs within bottomland hardwoods and those mixed and semiwooded areas adjacent to the bottomland hardwoods. Using a worst case assumption, demand could be considered equal to the supplies within the project area and all potential gains or losses would be considered as net project gains or losses.

The FWS proposed compensation area consists of 22,700 acres of bottomland hardwoods, 6,300 acres of semiwooded and 4,400 acres of openland habitats. Sport and commercial hunting values indicated in Table 23 reflect the results of management of all habitats to the HUV level of 90 as indicated within the terrestrial section of this report. The analysis

indicates that a well balanced sport and commercial harvest program could be maintained on the proposed compensation area.

Table 22. Potential Gains and Losses of User-Days of Sport Hunting and Returns to Fur Trappers as a result of Implementation of Evaluated Project Alternatives 1/

Sport Hunting (In User-Days)

Alternative	FES Plan	Cooper Lake - No Flood Control	Currently Recommended Plan	Non-Structural
Species:				
White-tailed deer	-2010	-865	-1265	+1442
Raccoon	- 846	-337	-502	+1551
Rabbit	-1846	-1040	-1296	+ 760
Quail	- 108	- 181	- 166	- 190
Squirrel	-8987	-3525	-5415	-7948
Dove	NS 2/	NS	NS	- 85
Turkey 3/	NS	NS	NS	NS
Coyote	- 199	- 270	- 237	+ 303
Fox	+ 14	+ 43	+ 40	+ 27

Commercial Trapping (In Dollars, 1974 Values)

Species: 4/				
Raccoon	-1027	- 448	- 637	+1072
Mink	- 98	- 52	- 75	+ 52
Opossum	- 686	- 321	- 426	+ 554
Coyote	- 195	- 182	- 208	+ 208
Bobcat	- 120	- 40	- 60	+ 40
Nutria	- 327	- 129	- 160	+ 366
Fox	- 140	- 98	- 112	- 294
Beaver	- 33	- 14	- 19	+ 359

1/ Average Annual gains (+) or losses (-) discounted at 3¼%

2/ NS indicates no significant impact

3/ Impacts to turkey is minimal due to extremely low populations, however, sufficient demand exists to consider management for this species within the compensation area

4/ Values reflect average dollar return per pelt as indicated: Raccoon, 6.50; Mink, 7.50; Opossum, 1.25; Coyote, 13.00; Bobcat, 20.00; Nutria 3.00; Fox, 14.00; and Beaver, 4.73.

Table 23. Annualized Sport Hunting and Returns to Commercial Trappers expected from the FWS Proposed Compensation Area 1/

Species	Sport Hunting 2/	Trapping 3/
White-tailed deer	1849	-
Raccoon	351	280
Rabbit	2404	-
Quail	746	-
Squirrel	4192	-
Dove	139	-
Coyote	189	234
Fox	116	224
Mink	-	128
Opossum	-	1438
Bobcat	-	140
Nutria	-	126
Beaver	-	274

1/ Discounted at 3¼%
2/ In User-Days
3/ In Dollars, 1974 Values

DISCUSSION

Aquatic

Due to extensive water development and stream alteration occurring on a national scale, riverine systems are a vanishing resource and every attempt should be made to mitigate additional losses. Channelization and reservoir construction have already altered or destroyed 59% of the Sulphur River Basin's main streams. The construction of Cooper will raise this figure to a conservative estimate of 72%. Short of providing more structure or modifying the channel, streamflow management is the only feasible method of compensating for stream losses (due to inundation by a reservoir). Concern is evidenced in the President's Environmental Quality and Water Resources Management Memorandum dated July 12, 1978.

> "...Federal agencies shall establish and provide for the streamflow necessary to maintain instream needs below proposed dams..."

The FWS submitted instream flow requests, in an effort to mitigate for stream losses resulting from project impacts on two separate occasions, July 13, 1966 and September 3, 1976. These requests preceded complete obligation of the reservoir's dependable yield, and yet no apparent effort was made to incorporate the FWS' recommendations. The 5 cfs proposal presented in a letter dated October 6, 1966, from the CE to the FWS was not biologically justified, and, to date, is considered inadequate.

This lack of consideration is still predominant in the Draft SES. Compensation for riverine losses has become a major difference in opinion between the FWS and the CE.

The FWS recognizes that the Sulphur River Basin does not contain a high quality fishery, but much of the system's demise came from past actions, performed in part by the CE. Although mitigation for past actions is not warranted in this situation, the FWS contends that these past actions should neither provide a foundation upon which further degradation is justified, nor assert that mitigation of additional losses is unjustified.

Subsequent to the August 19, 1980 Planning Aid letter, the CE proposed a "tailing off" of 5% of the project's floodpool in addition to the 5 cfs minimum for the purpose of providing downstream releases (5+5 plan). In other words, any water within the lower 5% of the floodpool would be retained and released gradually at a specified rate. The CE data indicate, for the early project years, that the frequency of a 50 cfs flow would exceed the existing frequency by as much as 25% in May (a time of normal surplus) to as little as 3% in August (a time of normal shortage). However, in the later project years the 50 cfs frequency is reduced below existing rates by 13% in May and 9% in August. Since the supply contracts are based on reservoir elevation, and since no accounting system apparently applies to the floodpool, then the water retained in the floodpool is indirectly used by all contractors (withdrawal from the conservation pool lowers the water level in the floodpool). Water retained in the floodpool increases the reservoir's dependable yield and serves as a buffer against evaporation losses within the conservation pool.

Although the plan provides a limited amount of mitigation on an interim basis, it does not constitute a mitigation plan over the life of the project. The 5+5 plan is a better proposal than the 5 cfs alone, but it is still unacceptable by itself. As indicated in a letter dated October 10, 1980 from the FWS to the Corps, the possibility still exists of obtaining unused project water (e.g. storage, sediment pool storage, conversion of floodpool storage, stage filling, etc.) in conjunction with the 5+5 plan to achieve an acceptable mitigation plan. To date, the CE has not shown that all water is unavailable for downstream releases. Until such a showing is made, the FWS can not accept the CE plan. Any proposal which provides less habitat in the downstream area, than currently exists, can not be viewed as a compensatory action designed to offset upstream losses. The CE plan, therefore, does not appear to satisfy the President's memorandum, nor the court's directive to correct deficiencies in providing adequate mitigation measures for losses of fish and wildlife habitat.

Stage filling is yet another unresolved issue. The CE has studied the feasibility of stage filling and has expressed a number of reasons for opposing such an action. These reasons are summarized in the following list:

(1) Water supply studies indicate that more than half of the storage will be required within 20 years.

(2) Recreational facilities would be lost when the second stage is reached.

(3) The smaller initial pool would reduce the lake fishery and reduce economic benefits.

(4) Lake fluctuations, which would result from the regulated release of water above the initial stage, would have adverse impacts on the reservoir.

In addressing the first point, the FWS believes that twenty years is sufficient time between stages to be beneficial to the lake fishery and provide water on an interim basis for downstream releases. The CE has already proposed a solution to point number two by designing the facilities to include the relocation of the boat ramps only. As far as point number three is concerned, stage filling provides more overall fishery benefits on an average annual basis than an immediate fill. Finally lake fluctuation, attributed to the downstream fishery releases is considered to be insignificant, as compared to normal reservoir operation. Furthermore, the ability to fluctuate lake levels is a major management tool in a reservoir fishery.

In closing the aquatic section, one final point should be addressed. Since fish and wildlife resources in the project area are held in public trust for the people and by the people of the State of Texas, we believe that the Federal government should be cognizant of State's rights and provide equal consideration for those resources. In a 1976 memorandum written by the Attorney General's Office for the State of Texas, appropriative rights were aligned primarily with the storm and flood flows of a river. The memorandum stated that waters needed for resources held in public trust, should be obtained from the normal (base) flow of the river, i.e., such water should be passed through any impounding structure. For the project to be in compliance with such an interpretation, the FWS advances the base flow issue for scrutiny by all agencies involved in the operation of Cooper Lake.

Terrestrial

The Wright Patman-White Oak Creek terrestrial habitat area which was recommended to the CE by the FWS during the planning process will compensate for terrestrial habitat impact resulting from the Currently Recommended Plan. The CE has proposed a mitigation area, though smaller in size, that is located in the same general location. The FWS area contains sufficient BLHW in a contiguous block to compensate for loss of this habitat type. Furthermore, land costs are considerably lower in this area than in the upper basin and many of these lands are already part of a flowage easement for Wright Patman Lake. These areas could possibly be adjoined to CE owned lands at Wright Patman to form a wildlife management area.

Development of the aforementioned food, cover, and water sources (Figures 4-6) as part of a habitat management plan, is expensive; however, certain costs are recoverable through sharecropping arrangements. Initial development is generally more cost effective than continuing to manage the same habitat from a 90.0 to 100.0 HUV. A point of diminishing returns is reached prior to the establishment of optimum conditions. Table 24 outlines the costs associated with habitat improvement. The increases from the existing HUV to 80.0 are generally attributed to successional changes. As an example, if existing waterholes were protected from grazing, a more productive aquatic plant community would develop. To increase the HUV above 80.0 for BLHW, either water hole development or selective clearing and thinning, is required.

Improvement to habitat under public ownership would result from better vegetation management by reducing livestock grazing. Certain areas will be fenced to exclude unwanted grazing. Excessive livestock grazing in BLHW reduces or eliminates ground cover. Included in this ground cover are seedlings of mast producing trees. Less desirable wildlife plants such as elm are not palatable to livestock and consequently develop into mature trees. This is the primary reason for the presence of mature cedar elm-hackberry stands often found where oaks and other mast producing trees once thrived. The forests were cut, grazing initiated, and the seedlings of mast producers were eaten while seedlings of less desirable wildlife trees were not utilized and developed into forest.

SW and OL habitat types in the project area have also been subjected to overgrazing by livestock. It is assumed that lands associated with the project which are acquired in public ownership would be managed for multiple objective purposes. Such management would include grazing regimes tuned to multiple objective purposes such as wildlife management timber harvest, and recreation.

All CE lands not required for project operation or immediate recreation development will be designated wildlife management lands. Some of these lands may be so designated on an interim basis because of anticipated future recreational development. Land management practices on these areas, including vegetative plantings, will be applied during construction. The effects of such practices were credited to the project during the compensation analysis.

CONCLUSIONS

Aquatic

Due to the scarcity of stream habitat, in the Sulphur River basin, the FWS's recommendation can only provide 45% compensation for project induced losses. This recommendation is contingent upon the identification of available water. The data analysis also presented two graduated contingency plans which provide 29% and 15% compensation, respectively. Implementation of the Corps 5+5 plan would not provide compensation for upstream habitat losses or maintain downstream habitat over the life of the project. The FWS, therefore, believes the CE aquatic mitigation plan is inadequate.

Table 24. Habitat Improvements and Related Costs at Various Levels of Management[1/]

	Habitat Type	Existing HUV	Target HUV 80.0	90.0	100.0
Water Hole Development	BLHW	68.0	None	3-0.5 acre ponds/section	9-0.5 acre ponds/section
	SW	48.5	None	3-0.5 acre ponds/section	9-0.5 acre ponds/section
	OL	33.0	None	3-0.5 acre ponds/section	9-0.5 acre ponds/section

$12,900 per pond x 3 ponds per section ÷ 640 acres = $60/acre average to achieve 90.0 HUV
$12,900 per pond x 9 ponds per section ÷ 640 acres = $181/acre average to achieve 100.0 HUV

	Habitat Type	Existing HUV	Target HUV 80.0	90.0	100.0
Clearing and Thinning	BLHW	68.0	None	3-1.0 acre tracts/section	8-1.0 acre tracts section
	SW	48.5	None	None	None
	OL	33.0	None	None	None

$450 per tract x 3 tracts ÷ 640 acres = $2/acre average to achieve 90.0 HUV
$450 per tract x 8 tracts ÷ 640 acres = $6/acre average to achieve 100.0 HUV

	Habitat Type	Existing HUV	Target HUV 80.0	90.0	100.0
Vegetative Plantings	BLHW	68.0	None	None	None
	SW	48.5	None	None	None
	OL	33.0	None	50 acres/section	115 acres/section

$1,100 per acre x 50 acres ÷ 640 acres = $85/acre average to achieve 90.0 HUV
$1,100 per acre x 115 acres ÷ 640 acres = $198/acre average to achieve 100.0 HUV

	Habitat Type	Existing HUV	Target HUV 80.0	90.0	100.0
Ground Denning Areas	BLHW	68.0	None	None	None
	SW	48.5	None	2 areas/section	5 areas/section
	OL	33.0	None	2 areas/section	5 areas/section

$1,600 each x 2 areas ÷ 640 acres = $5/acre average to achieve 90.0 HUV
$1,600 each x 5 areas ÷ 640 acres = $12/acre average to achieve 100.0 HUV

1/ July 1974 Prices.

Terrestrial

The FWS accepts the terrestrial mitigation plan proposed by the CE in the DSES. The plan will compensate for 88% of the expected habitat losses; however, if the losses resulting from past actions were included, the compensation figure would drop to 27%. Adequate mitigation plans for the remaining project alternatives have been recommended by the FWS.

Intensive management of mitigation lands to a HUV level of 90.0 is the most cost effective approach. Management of existing conditions to a level less than 90.0 would require more land (additional costs) in order to achieve the same amount of compensation. Management of the lands to a level greater than 90.0 would be expensive and would not gain a commensurate level of habitat units for dollars spent.

RECOMMENDATIONS

Based upon the information provided prior to January 26, 1981, by your agency, the Fish and Wildlife Service recommends that:

1. The Corps of Engineers adopt and implement the following schedules for Cooper Lake:

   a. Upon completion of the impoundment structure, a continuous release of 5 cfs be implemented until a normal operating level is reached or until Stage 1 is reached.

   b. Once the normal operating level or Stage 1 is reached, a continuous release schedule of (1) 45 cfs for months September through February, (2) 50 cfs for the months March and April, and (3) 30 cfs for the months of May through August be implemented.

   c. During a mild drought period (ex. one-in-four year low flow), the above recommendation (1b) be reduced by 10 cfs.

   d. During a more significant drought period (ex. one-in-seven year low flow) the recommendation be reduced to (1) 25 cfs for the months of September through January, (2) 35 cfs for the months February and March, (3) 25 cfs for April, (4) 20 cfs for May, (5) 14 cfs for June and (6) 10 cfs for the months July and August.

   e. During a severe drought period (ex. one-in-ten year low flow) the recommendation be reduced to a continuous release of 5 cfs for all months.

2. Cooper Lake be impounded in two phases to complement the water supply/demand analysis.

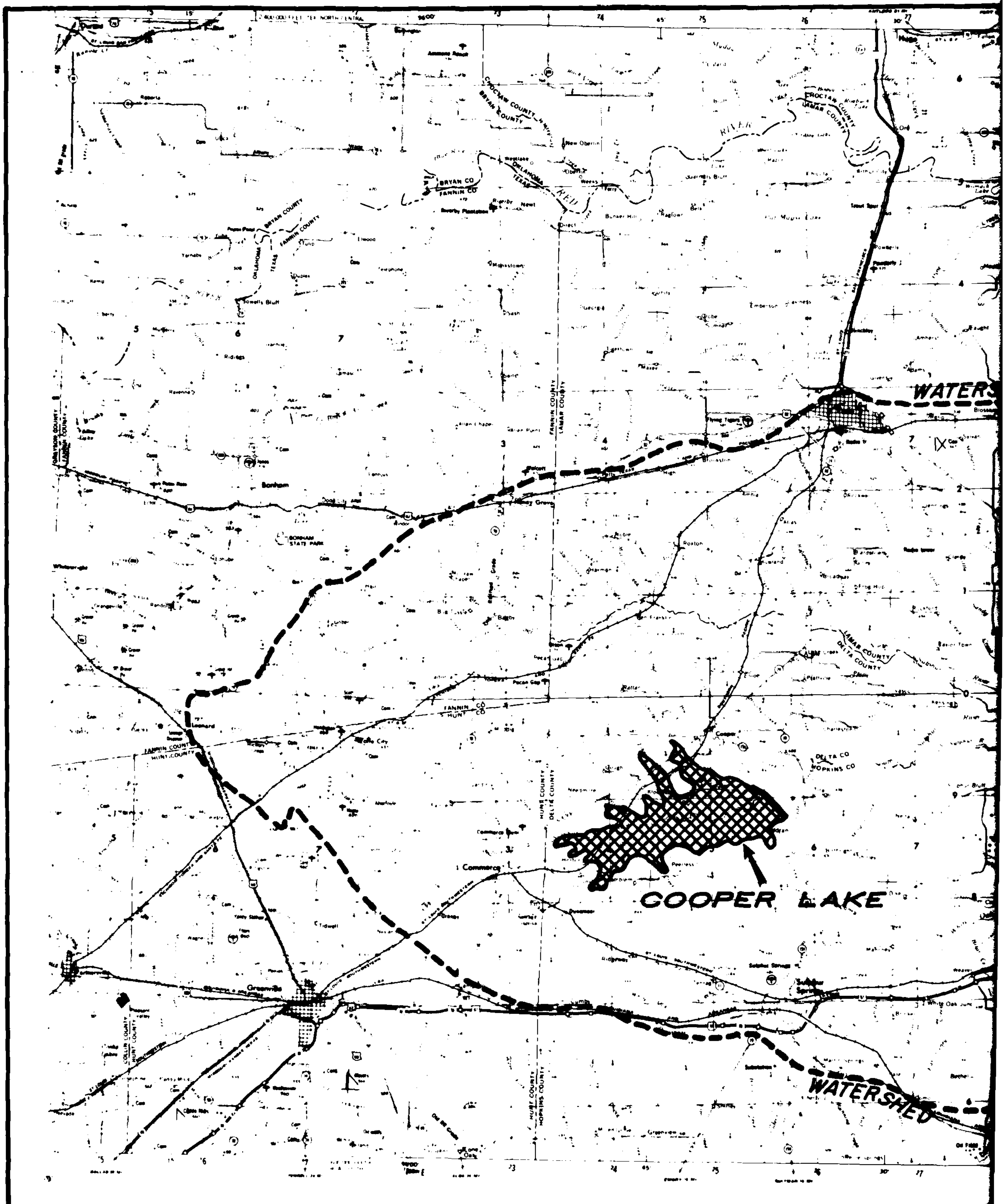
3. The Corps of Engineers proceed with the terrestrial habitat mitigation plan as presented in the Draft Supplemental Environmental Statement.

4. The terrestrial mitigation plan be implemented concurrent with project construction.

5. When the terrestrial mitigation area has been acquired in fee simple title, its boundary line fenced and the initial plantings of selected flora completed by the Corps of Engineers, the area be transferred to the Texas Parks and Wildlife Department for administration under terms of a General Plan in accordance with the provisions of and under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

6. The Fish and Wildlife Service be provided an opportunity to participate in the preparation of the Master Plan for Cooper Lake project.

The Service appreciates the opportunity to participate in project planning. Joint team efforts by our agencies have materially assisted in meeting the short deadlines for this complicated project.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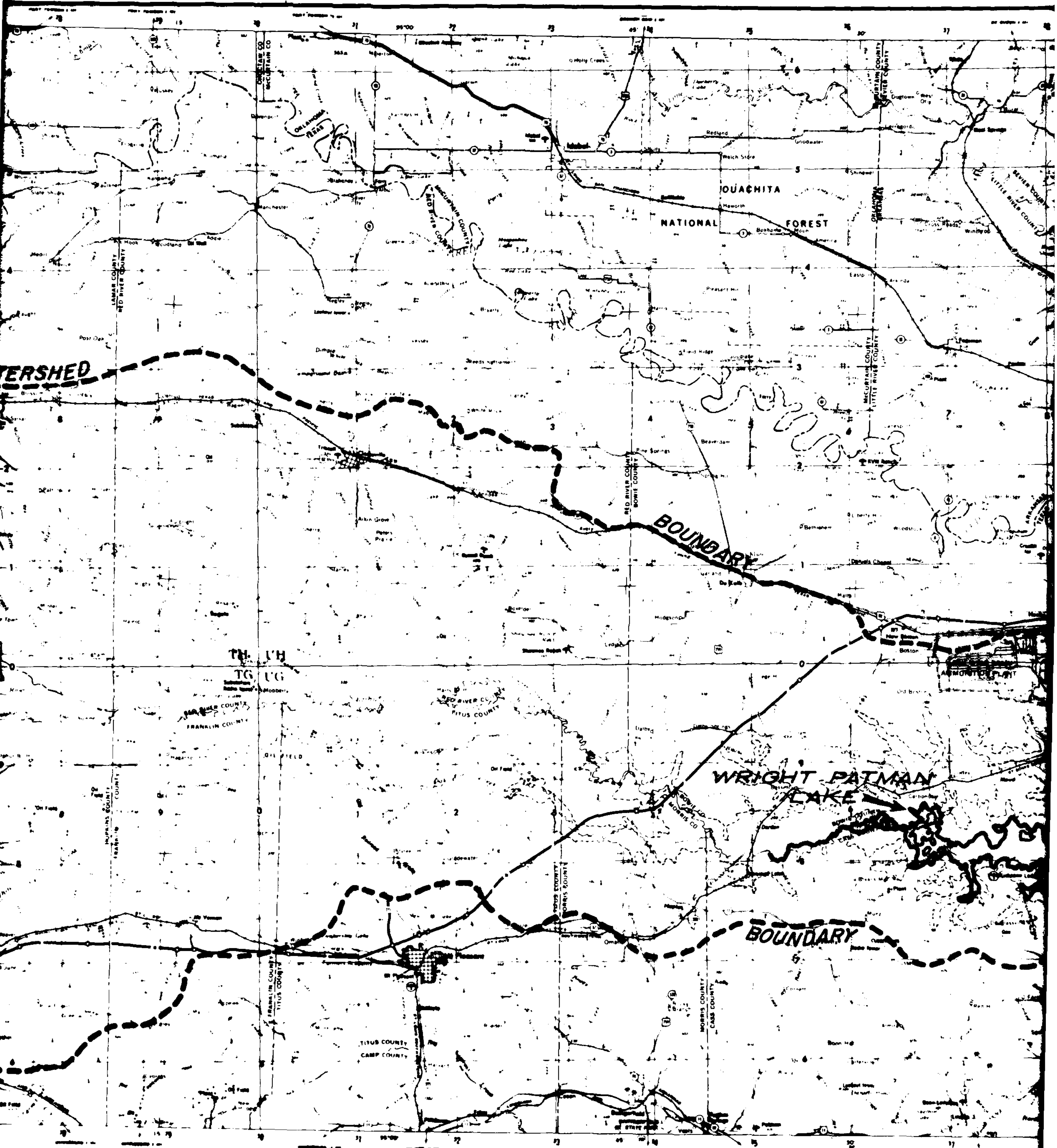
BRYAN CO
FANNIN CO
OKLAHOMA
TEXAS
BRYAN COUNTY
FANNIN COUNTY
FANNIN COUNTY
LAMAR COUNTY
Bonham
BORHAM
STATE PARK
FANNIN CO
HUNT CO
FANNIN COUNTY
HUNT COUNTY
LAMAR COUNTY
DELTA COUNTY
DELTA CO
HOPKINS CO
HUNT COUNTY
DELTA COUNTY
HUNT COUNTY
HOPKINS COUNTY
Commerce
Greenville
Leonard
Cooper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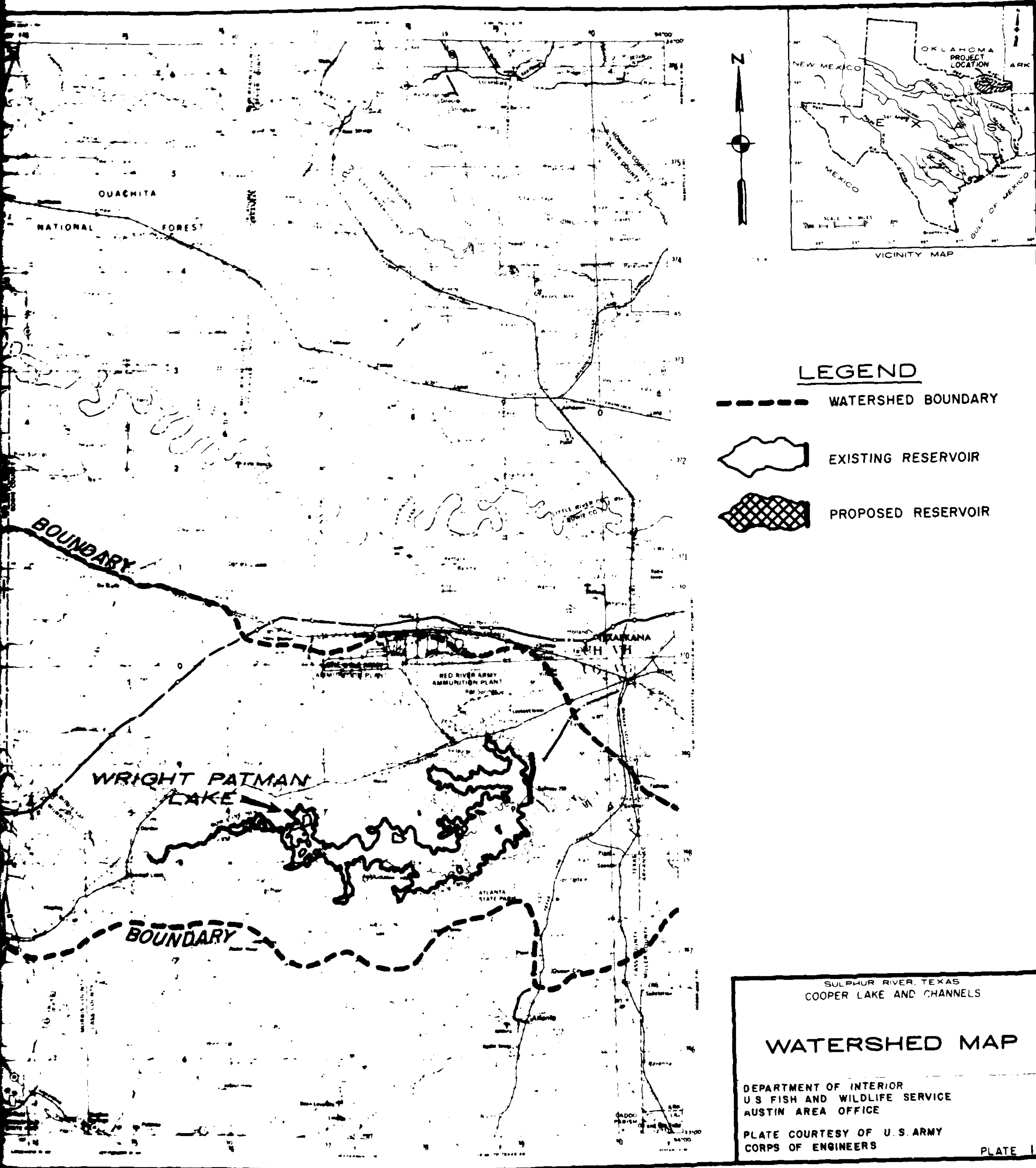
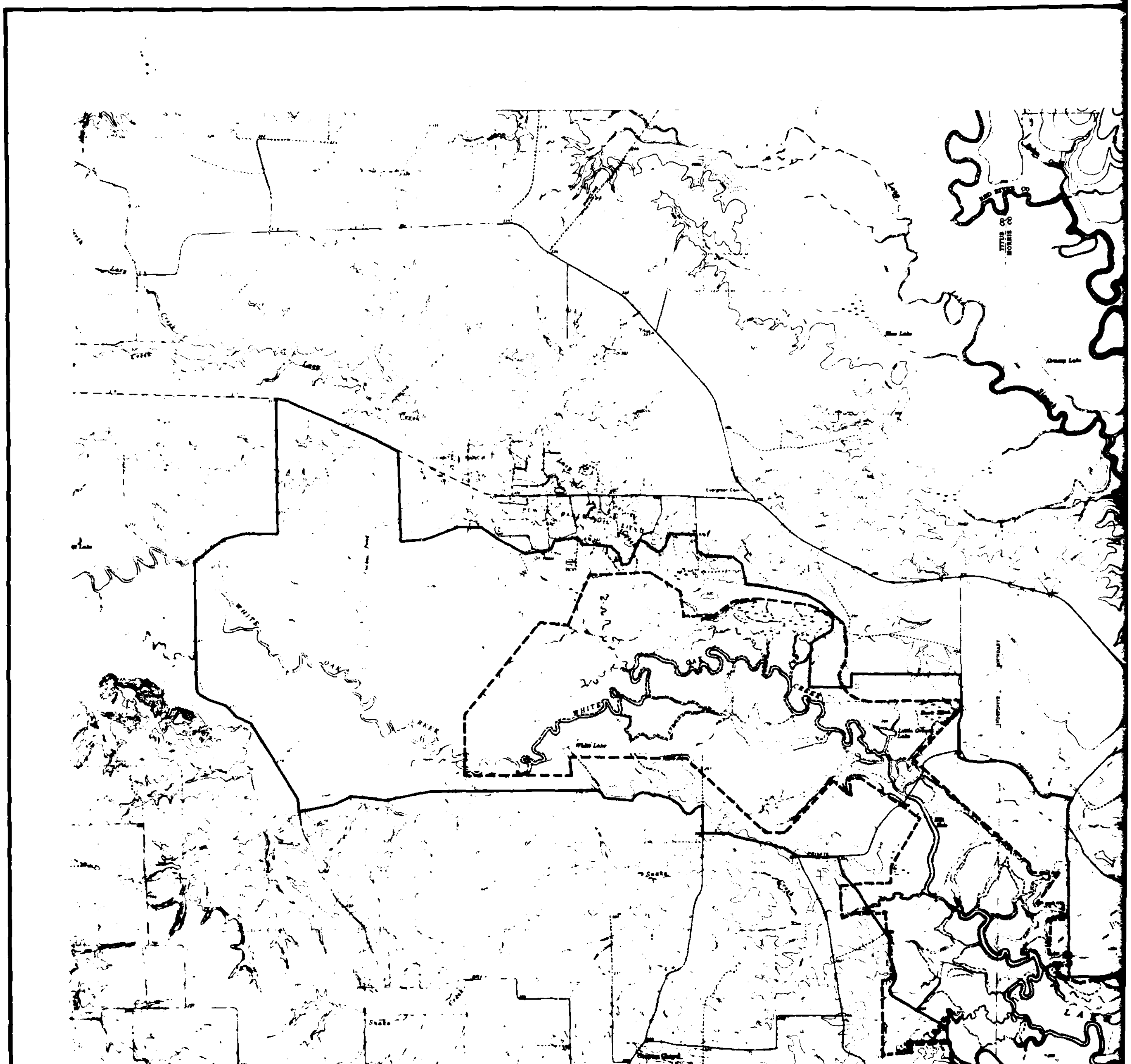
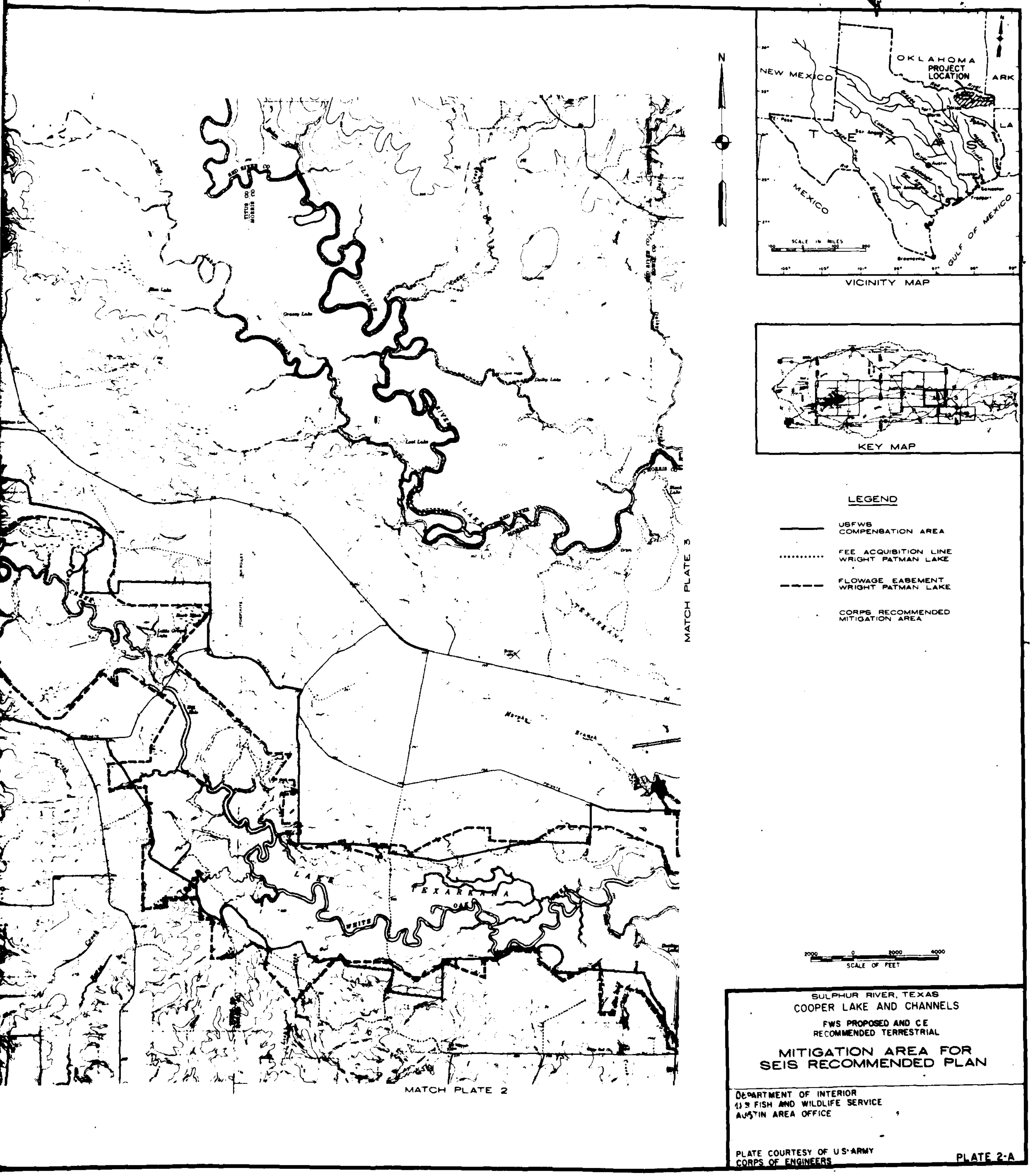
BOUNDARY
OUACHITA
NATIONAL
FOREST
WRIGHT PATMAN
LAKE
BOUNDARY

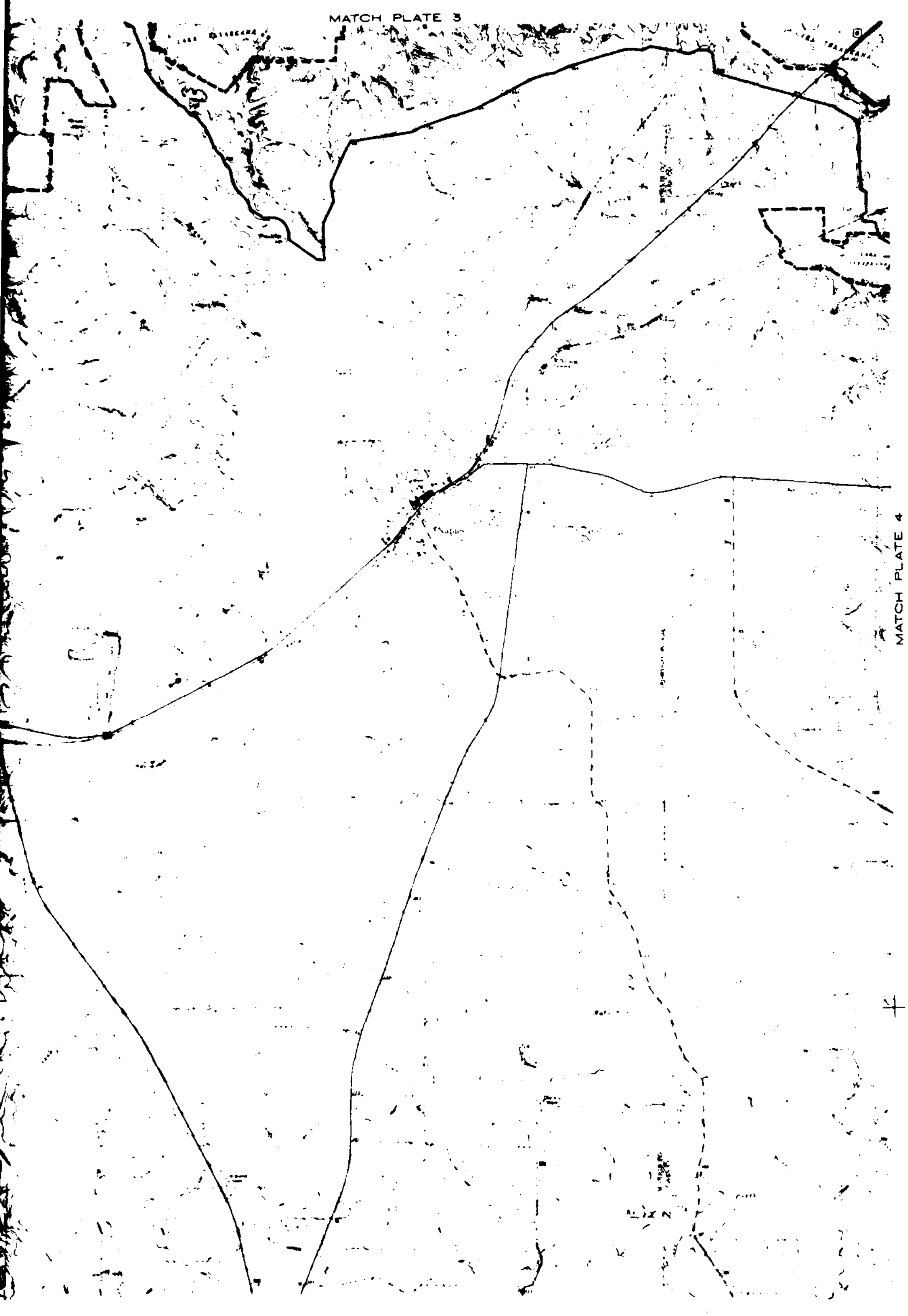

OUACHITA
NATIONAL FOREST
BOUNDARY
TEXARKANA
RED RIVER ARMY AMMUNITION PLANT
WRIGHT PATMAN LAKE
ATLANTA STATE PARK
BOUNDARY
OKLAHOMA
PROJECT LOCATION
NEW MEXICO
ARK
LA
TEXAS
MEXICO
GULF OF MEXICO
VICINITY MAP
LEGEND
WATERSHED BOUNDARY
EXISTING RESERVOIR
PROPOSED RESERVOIR
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
WATERSHED MAP
DEPARTMENT OF INTERIOR
U S FISH AND WILDLIFE SERVICE
AUSTIN AREA OFFICE
PLATE COURTESY OF U. S. ARMY
CORPS OF ENGINEERS
PLATE 1

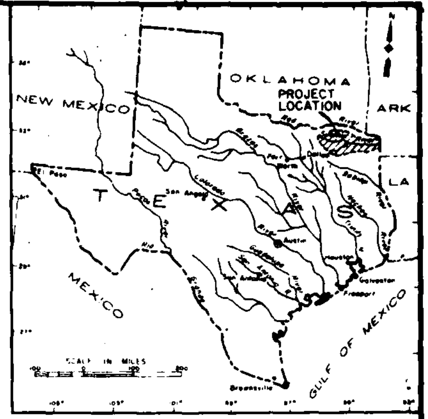




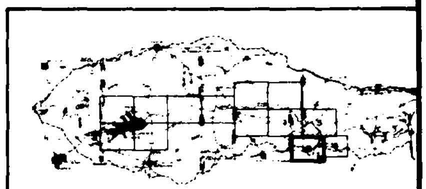
N
OKLAHOMA
NEW MEXICO
PROJECT LOCATION
ARK
LA
T E X A S
MEXICO
GULF OF MEXICO
SCALE IN MILES
VICINITY MAP
KEY MAP
LEGEND
USFWS COMPENSATION AREA
FEE ACQUISITION LINE WRIGHT PATMAN LAKE
FLOWAGE EASEMENT WRIGHT PATMAN LAKE
CORPS RECOMMENDED MITIGATION AREA
MATCH PLATE 3
MATCH PLATE 2
SULPHUR
RIVER
LAKE
TEXARKANA
LAKE
TEXARKANA
WHITE OAK
TITUS
MORRIS
2000 0 2000 4000
SCALE OF FEET
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
FWS PROPOSED AND C E RECOMMENDED TERRESTRIAL
MITIGATION AREA FOR SEIS RECOMMENDED PLAN
DEPARTMENT OF INTERIOR
U S FISH AND WILDLIFE SERVICE
AUSTIN AREA OFFICE
PLATE COURTESY OF U S ARMY CORPS OF ENGINEERS
PLATE 2-A


MATCH PLATE 1
MATCH PLATE 3





VICINITY MAP



KEY MAP

LEGEND

USFWS COMPENSATION AREA

FEE ACQUISITION LINE WRIGHT PATMAN LAKE

FLOWAGE EASEMENT WRIGHT PATMAN LAKE

CORPS RECOMMENDED MITIGATION AREA

2000 0 2000 4000
SCALE OF FEET

SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS

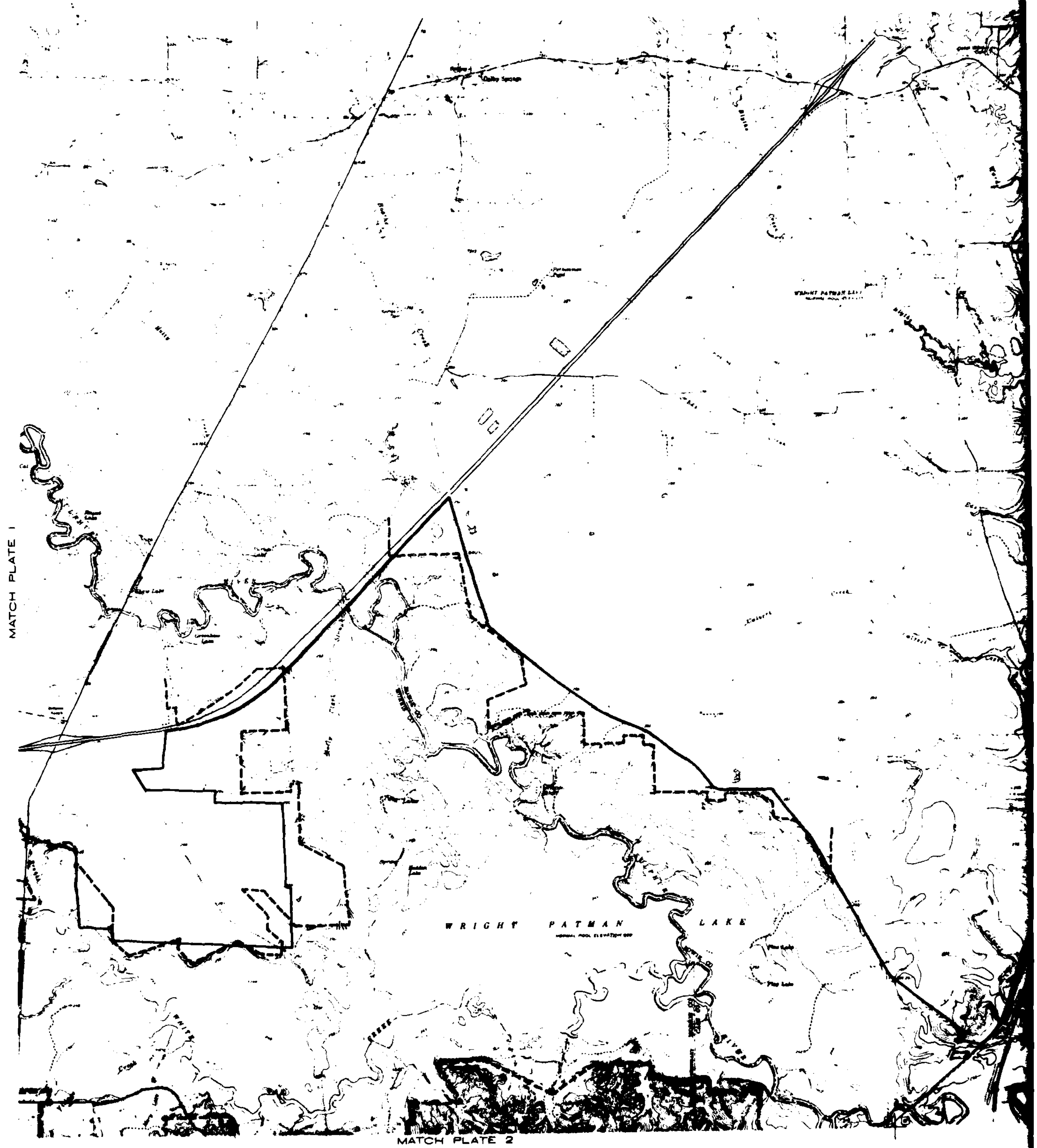
FWS PROPOSED AND CE RECOMMENDED TERRESTRIAL

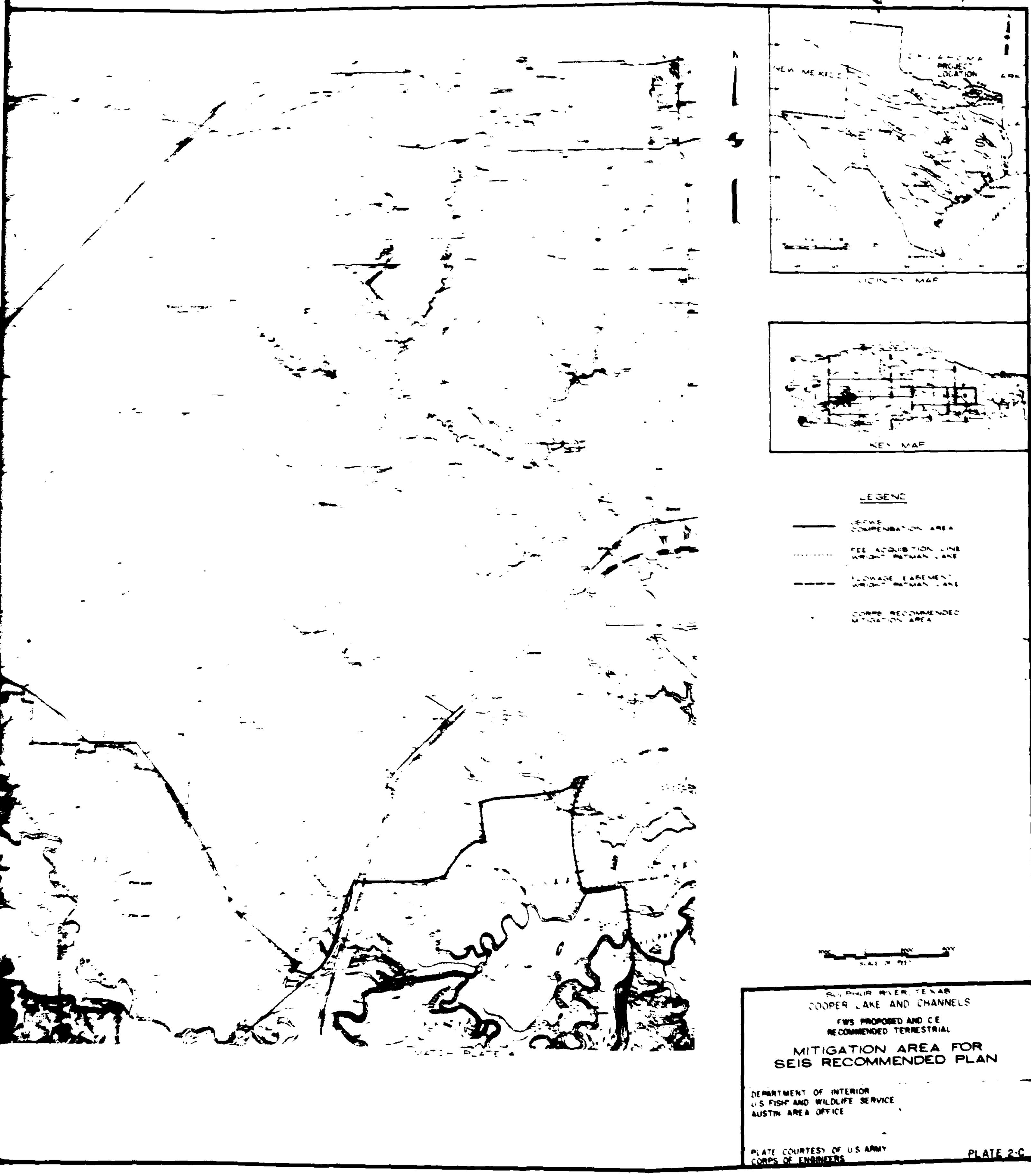
MITIGATION AREA FOR SEIS RECOMMENDED PLAN

DEPARTMENT OF INTERIOR
U S FISH AND WILDLIFE SERVICE
AUSTIN AREA OFFICE

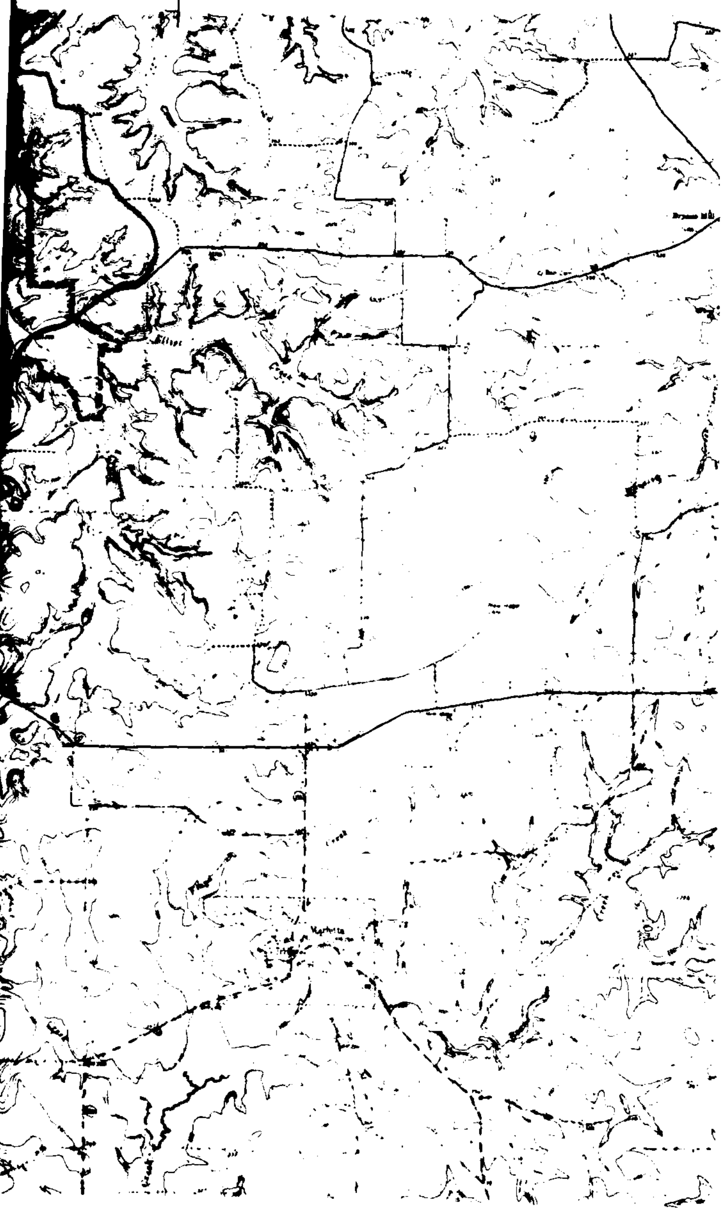
PLATE COURTESY OF U S ARMY CORPS OF ENGINEERS

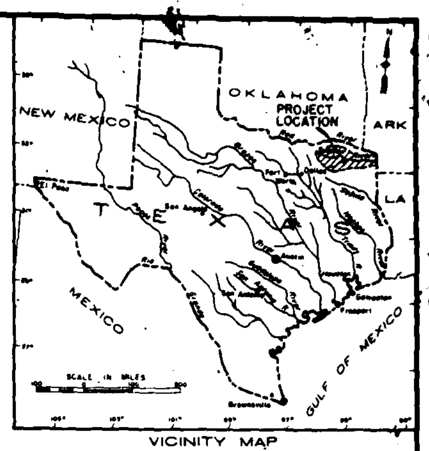
PLATE 2-B


MATCH PLATE 1
WRIGHT PATMAN LAKE
MATCH PLATE 2

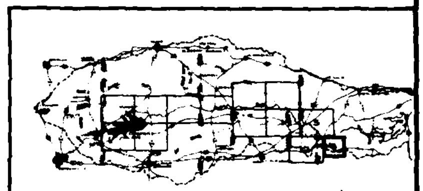

NEW MEXICO
PROJECT LOCATION
ARK
VICINITY MAP
KEY MAP
LEGEND
USFWS COMPENSATION AREA
FEE ACQUISITION LINE WRIGHT PATMAN LAKE
FLOWAGE EASEMENT WRIGHT PATMAN LAKE
CORPS RECOMMENDED MITIGATION AREA
SCALE OF FEET
MATCH PLATE 4
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
FWS PROPOSED AND C E
RECOMMENDED TERRESTRIAL
MITIGATION AREA FOR
SEIS RECOMMENDED PLAN
DEPARTMENT OF INTERIOR
U S FISH AND WILDLIFE SERVICE
AUSTIN AREA OFFICE
PLATE COURTESY OF U S ARMY
CORPS OF ENGINEERS
PLATE 2-C


MATCH PLATE 3
LAKE TEXARKANA
MATCH PLATE 2





VICINITY MAP



KEY MAP

N

LEGEND

USFWS COMPENSATION AREA

FEE ACQUISITION LINE WRIGHT PATMAN LAKE

FLOWAGE EASEMENT WRIGHT PATMAN LAKE

CORPS RECOMMENDED MITIGATION AREA

2000 0 2000 4000

SCALE OF FEET

SULPHUR RIVER, TEXAS

COOPER LAKE AND CHANNELS

FWS PROPOSED AND CE RECOMMENDED TERRESTRIAL

MITIGATION AREA FOR SEIS RECOMMENDED PLAN

DEPARTMENT OF INTERIOR
U S FISH AND WILDLIFE SERVICE
AUSTIN AREA OFFICE

PLATE COURTESY OF U S ARMY CORPS OF ENGINEERS

PLATE 2-D

DEPARTMENT OF THE ARMY
FORT WORTH DISTRICT, CORPS OF ENGINEERS
P. O. BOX 17300
FORT WORTH, TEXAS 76102

REPLY TO
ATTENTION OF:

SWFED-PR

29 SEP 1980

Mr. Jerome L. Johnson
US Fish and Wildlife Service
9A33 Fritz Lanham Building
819 Taylor Street
Fort Worth, Texas 76102

Dear 'Ir. Johnson:

This esponds to your letter dated August 19, 1980, providing data on fish and v ldlife impacts and recommendations on the Cooper Lake and Channels Proj t and alternatives under consideration in the supplemental EIS. I appr iate the efforts of you and your staff in expediting analysis of the fish and wildlife aspects of this important project.

Incl sure 1 is a response with brief rationale for acceptance or rejection of e h of the recommendations provided in your planning aid letters of Dece er 4, 1979, and August 19, 1980. A more detailed response and analysis will e included in the draft supplemental EIS for your review and consideration rior to your completion of the Coordination Act Report on this project. By s arate letter, I have made specific comments on the planning aid analysis prov ied in your August 19, 1980, planning aid letter for your consideration in preparing the Coordination Act Report.

I regret that I cannot accept in total the planning aid letter recommendations. I do believe, however, that the recommendations I have accepted, and those modified in part by my staff to optimize the overall project benefits, will adequately mitigate net adverse fish and wildlife losses due to the recommended Cooper Lake Project.

If I can be of assistance to you in completing the Coordination Act Report, please feel free to call on me.

Sincerely,

DONALD J. PALLADINO
Colonel, CE
District Engineer

1 Incl
As stated

Appendix B
Exhibit 2

Response to Planning Aid Recommendations

Planning Aid Letter December 4, 1979 (Summarized in Planning Aid Letter Dated 19 August 1980).

Comment. We recommend that the following considerations be incorporated into the Cooper Lake and Channel Project planning.

Surface water supplies, if developed, be planned to obtain maximum multiple use.

Multiple maximum use includes scheduled releases of water from the Cooper Lake Project, if constructed, and the existing Wright Patman Lake in event storage is reallocated.

Response. Optimum multiple use is, and will continue to be, a factor in the development of Cooper Lake. Storage reallocation or release schedule changes at the existing Wright Patman Lake is beyond the scope of the Cooper Lake Project study, but will be considered in future feasibility studies for storage conversion at Wright Patman Lake, or in conjunction with ongoing water quality studies.

Comment. Storage of these waters for flow release be provided by fine tuning of reservoir storage at the above named projects.

Response. Multiple use of storage provided in Cooper Lake for downstream purposes is not possible. Flood storage capacity in Cooper Lake is designed to provide protection to downstream agricultural lands. Holding of more than a minor portion of this storage to make downstream multiple-purpose releases for fish and wildlife increases the risk of flooding to these developed lands. Multiple use of water supply storage in the two reservoirs is also not possible since the water supplies are used by different entities in different locations within the state. The Cooper Lake water supply is used upstream of Cooper Dam.

Comment. During considerations of flow releases to provide for multiple use of the basin surface waters, the outlet works for Wright Patman be studied with a view to providing for outlets at more than one level. Such outlets should provide water of sufficient quality, for the quantity of water released, to provide enough dissolved oxygen to meet water quality standards.

Response. An investigation of water quality below Wright Patman Dam and effects of structural modification to the outlet works was conducted by the Corps (New Orleans District) culminating in a report dated 16 July 1979. The conclusion reached in that investigation, utilizing a selective withdrawal model (SELECT), was that provision of multiple-level outlet structures would not substantially improve the quality of released water, but would serve to deplete available dissolved oxygen in the reservoir. Dissolved oxygen in released water met all applicable criteria during the years 1975-1977. In 1978, a low runoff year, the lower Sulphur River Basin did experience low dissolved oxygen concentrations, in both the reservoir and downstream channel areas. The Corps has a continuing program of evaluating water quality within and downstream of operating projects. This recommendation, however, is not applicable to Cooper Lake and Channels Project.

Comment. Selected flood plain lands and adjoining uplands downstream from the proposed Cooper Lake and upstream from Wright Patman Lake be considered as a means to mitigate any terrestrial habitat losses.

Response. These lands were considered in selecting, evaluating, and recommending mitigation plans to compensate for net adverse terrestrial losses. The Corps recommended mitigation plan includes acquisition and management of lands below Cooper Dam and upstream of Wright Patman as requested.

Comment. Natural flood storage areas also be designated wildlife areas in any lands used for nonstructural flood control.

Response. There are no true natural flood storage areas identified in the Sulphur River Basin. The existing flood plain does function to spread out and slow overbank discharges. The nonstructural plan evaluated in the SEIS designates a habitat zone within the 3-year frequency flood plain. This plan is not selected for implementation in the SEIS.

Comment. Any new or existing levees that may become a part of the Cooper Lake and Channels Project be acquired in public ownership. These lands should be managed for wildlife production and nature trails.

Response. The only levee proposed to be constructed with the Reservoir Only plan now recommended is a Spur 4RSS which is needed in conjunction with the outlet channel for Cooper Lake. This spur will continue to provide protection to existing developed land. Approximately 750 acres of land downstream of the dam and upstream of Highway 19/154 are proposed for purchase as part of the Reservoir Only plan. This land is needed for multiple purposes of flowage regulation at the 3000 c.f.s. discharge, mitigation of bottomland hardwood terrestrial losses, and public use. About 3 miles of existing levee adjoin this tract, and a nature trail system is proposed by the Corps along this levee and the new Spur 4RSS between the dam and Highway 19/154. Existing levees in the Sulphur River flood plain are owned, operated, and maintained by non-Federal local interests under past agreements, or are privately owned and operated.

Planning Aid Letter Recommendations, August 19, 1980

USFWS Recommendation. Any levees which are part of the project be managed for wildlife diversity.

Corps Response. The only levee proposed to be constructed with the Reservoir Only plan now recommended is a Spur 4RSS which is needed in conjunction with the outlet channel for Cooper Lake. This spur will continue to provide protection to existing developed land. Approximately 750 acres of land downstream of the dam and upstream of Highway 19/154 are proposed for the purchase as part of the Reservoir Only plan. This land is needed for multiple purposes of flowage regulation at the 3000 c.f.s. discharge, mitigation of bottomland hardwood terrestrial losses, and public use. About 3 miles of existing levee adjoin this tract and a nature trail system is proposed by the Corps along this levee and the new Spur 4RSS between the dam and Highway 19/154. Existing levees in the Sulphur River flood plain are owned, operated, and maintained by non-Federal local interests under past agreements, or are

privately owned and operated. All levees, however must be maintained in a condition which primarily will fulfill its flood control purpose. Within the levees adjacent to the river, and interior drainage facilities and borrow areas can be managed for their wildlife value.

USFWS Recommendation. Any levees which are part of the project be designated for public use nature trails.

Corps Response. See response above. Levee Spur 4RSS will be publically accessible and trail access will be provided.

USFWS Recommendation. Any lands designated for nonstructural flood control be designated as wildlife lands. Such land should be acquired in public ownership.

Corps Response. There are no true natural flood storage areas identified in the Sulphur River Basin. The existing flood plain does function to spread out and slow overbank discharges. The nonstructural plan evalated in the SEIS designates a habitat zone within the 3-year frequency flood plain. This plan is not selected for implementation in the SEIS. There are no lands acquired for nonstructural flood control with the Reservoir Only plan.

USFWS Recommendation. To compensate for terrestrial wildlife losses resulting from implementation of the Cooper Lake with Flood Control, No New Channels or Levees (Reservoir Only) about 22,700 acres of bottomland hardwoods, 4,400 acres of open-land, 300 acres of semi-wooded and 6,000 acres of upland woods, as shown on a map which has been provided to your planners, be acquired and managed to a habitat unit value of nine at an estimated O&M cost of five dollars per acre (1980 costs)

Corps Response. The Corps accepts compensation recommendations for bottomland hardwood habitat losses. The Corps recommends acquisition, development and management of about 25,000 acres within the area generally as proposed by USFWS. The Corps also recommends terrestrial habitat mitigation features on project lands at Cooper Lake, and lands downstream of Cooper Dam.

USFWS Recommendation. That compensation lands include those adjoining the upper end of Wright Patman Lake and extend upstream in the White Oak Creek drainage.

Corps Response. The Corps recommended mitigation plan includes mostly these lands.

USFWS Recommendation. Study the feasibility of stage filling. If the study results are positive, and the time and elevation differences between Stage I and Stage II are acceptable for propagation of fish and wildlife, then we recommend stage filling.

Corps Response. The Corps does not accept stage filling recommendations for Cooper Lake. Corps feasibility analysis of stage filling potential at Cooper Lake resulted in a determination that short term benefits of stage filling were not as important as developing the full potential of the lake initally. In addition, Corps water needs studies indicate a need for more than half the yield, even with conservation, within 20 years of initial operation.

USFWS Recommendation. Include in the operations manual the following release schedules which are designed to mitigate unavoidable stream losses attributable to the creation of Cooper Lake.

a. Upon completion of the impoundment structure, a continuous release of 5 cfs should be implemented until normal operating level is reached or if stage filling is shown to be feasible, then until Stage I is reached.

b. Once the normal operating level or Stage I is reached, a continuous release schedule of (1) 45 cfs for months September through February, (2) 50 cfs for the months March and April, and (3) 30 cfs for the months May through August should be implemented.

c. During a mild drought period (ex. one in four year low flow), the above recommendation (7b) should be reduced by 10 cfs

d. During a more severe drought period (ex. one in seven year low flow), the recommendation should be reduced to (1) 25 cfs for the months September through January (2) 35 cfs for the months February and March, (3) 25 cfs for April, (4) 20 cfs for May, (5) 15 cfs for June. and (6) 10 cfs for the months July and August.

e. During an even more severe drought period (ex. one in ten year low flow), the recommendation should be reduced to a continuous release of 5 cfs for all months.

Corps Response.

a Accepted. This recommendation will be included in the deliberate impoundment plan.

b Rejected. The Corps cannot make a continuous release as requested. The Corps will include in the Operation Plan a procedure for holding 5% of the flood pool, and making releases at the rate requested for each month when this storage is available. A 5 cfs continuous low flow release will be made when lake elevations are below 440 feet msl.

c , d., and e. These releases could also be made, as requested, part of the time through use of retained flood pool storage. However, droughts cannot be predicted and the contingency plans would have to be based on lake levels. Since the Corps plan only utilizes captured flood storage, drought contingency plans are a moot point since elevations of the lake direct the implementation of the USFWS recommended flow when possible.

USFWS Recommendation. List and analyze the techniques available for predicting droughts and relate these findings to the implementation of the above drought contingency plans.

<u>Corps Response</u>. There are no techniques for predicting long term droughts. The maximum rainfall forecast currently used by the National Weather Service is about 3 months, though studies are currently being done to extend forecasts to 1 year. Drought years in North Central Texas and east Texas have occurred on an average frequency of once every 7 years, and two consecutive drought years have occurred on the average of one every 15-20 years. There is, however, no proven way to predict droughts, or to determine if a current drought will continue into the future. The only way to develop contingency plans for downstream releases is to utilize reservoir levels. Since water supply storage is not available for making downstream releases, lake elevations in the flood pool are the only means available for developing contingency plans for Cooper Lake.

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
Ecological Services
9A33 Fritz Lanham Building
819 Taylor Street
Fort Worth, Texas 76102

August 19, 1980

Colonel Donald J. Palladino
District Engineer
Corps of Engineers, U.S. Army
P.O. Box 17300
Fort Worth, Texas 76102

Dear Colonel Palladino:

The purpose of this letter is to provide you the results of our aquatic and terrestrial analysis for the Cooper Lake and Channels Project. There are two separate attachments which contain the evaluations, methodologies, results and recommendations for the aquatic and terrestrial analysis, respectively. For your convenience, we have included the recommendations from both the aquatic and terrestrial attachments in the text of this letter. This is part of our continuing efforts to provide information as timely as we possibly can for your use in preparing the draft supplemental environmental impact statement. Please be aware that this letter and the two attachments are planning aid level information and do not represent a report of the Fish and Wildlife Service under the terms of Section 2b, of the Fish and Wildlife Coordination Act.

We also would like to summarize the information which we have previously provided to your staff. During our mutual planning efforts, we have provided information through eleven formal letters and numerous meetings. In addition, we have been to the project area on several occasions with your planners and biologists from the Texas Parks and Wildlife Department. You will recall that in our letter of December 4, 1980, which was soon after our assumption of responsibilities for the Fish and Wildlife Service in this project study, we provided you with an overview of considerations we believed (and still do) were of utmost importance in developing a multi-objective Cooper Lake and Channels water resource project.

In this overview, we requested a flow release schedule for fishery habitat from Cooper Lake into the downstream Sulphur River and through Wright Patman Lake into the river below. We suggested a siphon or some type of multiple level outlet structure for the water which would be passed from Wright Patman Lake. Such an outlet would insure suitable water quality into the river downstream from Wright Patman Lake. Water quality is now sometimes deficient because of a lack of dissolved oxygen.

We suggested that any newly constructed or existing levees be managed for wildlife diversity and that the levees could be used as nature trails for non-consumptive wildlife and photography use. Such use would be facilitated by public ownership of the levees.

Appendix B
Exhibit 2

We requested terrestrial mitigation consideration in selected floodplain areas between Cooper Lake and Wright Patman. We pointed out that any lands which are designated for non-structural flood control should also be designated as wildlife lands.

Our efforts thus far have followed in line with the overview as reviewed above. However, because of time constraints and the magnitude of the overall task, we have not initiated studies concerning the need for downstream flows below Wright Patman Dam. In this regard, we believe it is necessary that the flows recommended downstream from Cooper Lake be passed through Wright Patman Lake on an interim basis. During this interim, studies should be conducted to determine streamflow needs in areas downstream from Wright Patman Lake. Also, a multiple level outlet structure to pass water from Wright Patman Lake should be investigated.

Listed below are the recommendations we believe are necessary to adequately consider the aquatic and terrestrial ecosystems as part of this project.

Recommendations

1. Any levees which are part of the project be managed for wildlife diversity.

2. Any levees which are a part of the project be designated for public use nature trails.

3. Any lands designated for non-structural flood control be designated as wildlife lands. Such land should be acquired in public ownership.

4. To compensate for terrestrial wildlife losses resulting from implementation of the Cooper Lake with Flood Control, No New Channels or Levees (Reservoir Only) about 22,700 acres of bottomland hardwoods, 4,400 acres of openland, 300 acres of semiwooded and 6,000 acres of upland woods, as shown on a map which has been provided to your planners, be acquired and managed to a Habitat Unit Value of Nine at an estimated O&M cost of five dollars per acres (1980 costs).

5. That compensation lands include those adjoining the upper end of Wright Patman Lake and extend upstream in the White Oak Creek drainage.

6. Study the feasibility of stage filling. If the study results are positive, and the time and elevation differences between Stage I and Stage II are acceptable for propagation of fish and wildlife, then we recommend stage filling.

[illegible] in the operations manual, the following release [illegible] which are designed to mitigate unavoidable [illegible] attributable to the creation of Cooper Lake.

a. Upon completion of the impoundment structure, a continuous release of 5 cfs should be implemented until normal operating level is reached or if stage filling is shown to be feasible, then until Stage I is reached.

b. Once the normal operating level or Stage I is reached, a continuous release schedule of (1) 45 cfs for months September through February, (2) 50 cfs for the months March and April, and (3) 30 cfs for the months May through August should be implemented.

c. During a mild drought period (ex. one in four year low flow), the above recommendation (7b) should be reduced by 10 cfs.

d. During a more severe drought period (ex. one in seven year low flow) the recommendation should be reduced to (1) 25 cfs for the months September through January, (2) 35 cfs for the months February and March, (3) 25 cfs for April, (4) 20 cfs for May, (4) 15 cfs for June and (5) 10 cfs for the months July and August.

e. During an even more severe drought period (ex. one in ten year low flow), the recommendation should be reduced to a continuous release of 5 cfs for all months.

8. List and analyze the techniques available for predicting droughts and relate these findings to the implementation of the above drought contingency plans.

We are most appreciative of the assistance which has been received from your planning staff. I am also appreciative of the endless calculations done by your two technicians which assisted us in our aquatic analysis.

If you have any questions concerning the analysis presented in the two attachments or our recommendations, please do not hesitate to call us. In this regard, it is important that you advise us as soon as possible concerning the status of our recommendations.

Sincerely,

Jerome L. Johnson
Field Supervisor

cc; RD, FWS, Albu. NM w/attchmts
AM, FWS, Austin, Tx. w/attchmts
TPWD, Austin, Tx. w/attchmts
Ark. Game & Fish Comm. Little Rock, Ark.
Attn: Dick Brooch, w/attchmts

APPENDIX C

ECONOMIC ANALYSIS

APPENDIX C

ECONOMIC ANALYSIS

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APPENDIX C

ECONOMIC ANALYSIS

INTRODUCTION

This section of the report contains detailed economic data on the investigation, analysis, and studies made by Fort Worth District (FWD) during 1979 and 1980 in connection with the Cooper Lake and Channel project. Recent studies involved a thorough reexamination of the economic aspects of providing for the development of the South Sulphur and Sulphur Rivers above Wright Patman Reservoir. This appendix documents FWD's study activities, describes the evaluation procedures, and displays estimates of the benefits that would be credited to the various plans investigated.

The principal aim for these studies was to respond to deficiencies of the final EIS for the project noted by the United States District Court, East District of Texas. In order to prepare the needed supporting economic data, a review was made of prior reports and studies. Formulation studies were performed which involved a reevaluation of various alternatives previously developed and evaluation of selected new alternatives, and a plan was selected which would best meet the water resource needs of the region. The scope of the current economic analysis encompassed estimating the total project benefits assignable to the various plans given detailed consideration in these studies. Particular emphasis was placed on determining the benefits for the recommended plan based both on 1974 price levels and development in order to have the estimates on a comparable level with cost information contained in the original EIS. The benefits also were calculated based on current 1980 conditions and prices.

The appendix is divided into three sections. Section I presents a summary display of the benefits assignable to the 22 alternative plans of improvement analyzed in previous studies. Responses to economic related deficiencies in the Environmental Impact Statement noted in the Court's December 8, 1978, Memorandum of Opinion are also contained in this section. Section II describes follow-up studies made by FWD in 1979 and 1980 on the alternative plans previously considered and on various new alternatives. As a result of these investigations, four alternative management plans were selected for detailed consideration. They are: (a) a multi-purpose reservoir and levee system; (b) a multi-purpose reservoir only; (c) a single purpose reservoir for water supply only; and (d) a comprehensive nonstructural plan. Benefit estimates are presented for these plans based on 1974 prices and conditions. Land use and economic data contained in previous reports and back-up files were referred to and utilized extensively in the development of these estimates. Section III documents economic evaluations made to update the project benefits for the recommended plan of improvement selected by FWD (multi-purpose reservoir only) to reflect 1980 prices and conditions.

APPENDIX C

SECTION I

ECONOMIC ANALYSIS

General

This section of the appendix describes and responds to the deficiencies relating to benefit/cost analysis noted in a Memorandum Opinion filed by the U.S. District Court, Eastern District of Texas, Paris Division on December 8, 1978. In general, the final EIS was deficient in the presentation of benefit/cost ratios and failure to show an analysis for those presented. The deficiencies noted are as follows:

- The plaintiffs alleged that some of the stated benefit/cost ratios are incorrect or biased and that requisite analysis of the benefit/cost ratios are inadequate or, in some instances, nonexistent.

- No tabulation is provided for dollar benefits from flood control and dollar losses of production from flood control works.

- Since no water supply alternative was presented, cost and benefits are lacking for this alternative.

- No benefits, and thus, no benefit/cost ratios were presented for acquisition by restrictive easement or nonrestrictive easement. No benefit/cost tabulations were provided for other nonstructural tools such as zoning, flood insurance, flood warning, and no integrated plan combining nonstructural tools offered.

- Questions were raised on procedures used in computing the benefit/cost ratio for the selected plan. Part of the estimated benefits were based on a Corps' prediction that the project would include a conversion from pasture and woodland to row crops. Such a conversion would reverse past trends in the area from row crop to pasture, the predicted reversal was not explained in the EIS or at the trial.

- The Corps failed to follow Principles and Standards in calculating recreational benefits and losses, and the final EIS failed to include any explanation of its decision to use the highest value for flatwater recreation and a low value for hunting recreation. The validity of the benefit/cost ratio thus remains at issue, pending clarification of these matters by the Corps.

Each of the deficiencies noted above are discussed in the following paragraphs which present benefit/cost analysis for alternatives evaluated in the final EIS.

Benefit Cost Study

The benefits, costs, and benefit to cost ratios for all alternative plans presented in the final EIS are shown in table 1. Descriptions of these plans may be found on pages I-1 and VI-1 through VI-41 of the EIS and General Design Memorandum No. 2-B Revised Supplement No. 1, Plan Selection Report, dated February 1977. The latter document also presents detailed cost and BCR estimates for the alternatives presented in the final EIS. These alternatives are reexamined in Appendix D, Plan Formulation, of the supplemental EIS. Benefits for the alternative plans were separated into five categories of flood control, water supply, recreation, fish and wildlife and area redevelopment. The flood control benefits were divided in sub-categories of agricultural, non-agricultural, intensification, and storage exchange. A description of the definitions for each of the benefit categories is presented in table 2. The computational methodologies used in developing the benefits for the final EIS alternatives are described in this section. With some modification, explained in Section II of this appendix, similar methods were adopted in developing benefits for the alternative plans presented in the supplemental EIS.

Flood Control Benefits - Methodology

Flood damages under status quo 1974 land use conditions in the Sulphur River flood plain occur from two basic sources. There are damages to and reduced productivity of pastureland, and damages to fences, farm equipment and structures, levees, roads, and bridges. The damages due to flooding of pastureland are calculated based on how the potential economic return of the land as it is utilized is affected by flooding. Under 1974 conditions, land utilization in the Sulphur River basin was almost entirely devoted to grazing. Two basic types of cattle operations are involved in the project area. These are cow-calf enterprises, generally involving one cow for every four acres of land and resulting in a weaned calf crop of about 78 percent under average management conditions; and stocker-calf enterprises, in which calves are purchased and generally grazed at the rate of 1.25 animals per acre with an average death loss of 4 percent under average management conditions. Under advanced management conditions cow-calf enterprises will support one cow for every two acres and result in a weaned calf crop of 90 percent, and stocker-calf enterprises will support 2.0 animals per acre with a death loss of about 2 percent.

The economic yield of an acre of grazing land depends on the type of operation, i.e., average or advanced. In the case of a cow-calf enterprise under average management, the yield based on an average calf weight of 400 pounds, a weaned calf crop of 78 percent with one

TABLE 1

SUMMARY OF ANNUAL BENEFITS, COSTS, AND BENEFIT TO COST RATIOS
FOR PLANS PRESENTED IN FINAL EIS
(1974 prices and level of development)

Plans Investigated	ANNUAL BENEFITS: Flood Control: Agricultural	Flood Control: Nonagricultural	Flood Control: Intensification	Flood Control: Storage Exchange	Flood Control: Sub Total	Water Supply	Recreation	Fish and Wildlife	Area Redevelopment	Total Benefits	Annual Charges	BCR	Net Benefits
	(in thousands of dollars)												
Structural													
Reservoir, levee, and channels (authorized)	$ 360.0	$ 292.0	$ 501.0	$ 100.0	$1,253.0	$1,728.0	$1,111.5	$ 355.5	$ 258.9	$4,706.9	$3,236.4	1.5	$1,470.5
Reservoir and channel	670.0	703.0	1,148.0	100.0	2,621.0	1,728.0	1,111.5	351.5	380.3	6,192.3	4,372.5	1.4	1,819.8
Reservoir and levees (EIS selected)	375.0	301.0	516.0	100.0	1,232.0	1,728.0	1,111.5	341.0	255.0	4,727.5	3,178.1	1.5	1,549.4
Reservoir, levee & channel w/land side levee borrow	367.0	293.0	493.0	100.0	1,253.0	1,728.0	1,111.5	355.5	259.0	4,707.0	3,243.0	1.5	1,464.0
Reservoir, levee w/channel adjacent to levees	370.0	298.0	506.0	100.0	1,274.0	1,728.0	1,111.5	349.8	258.9	4,722.2	3,235.4	1.5	1,486.8
Reservoir channel w/levee adjacent to channel	364.5	323.5	609.0	100.0	1,397.0	1,728.0	1,111.5	355.0	266.2	4,857.7	3,298.4	1.5	1,559.3
Reservoir & levee w/clearing and snagging	375.0	302.0	511.0	100.0	1,288.0	1,728.0	1,111.5	341.0	257.7	4,726.2	3,227.4	1.5	1,498.8
Reservoir & levee w/clearing & snagging major bend cutoffs	366.0	298.0	506.0	100.0	1,270.0	1,728.0	1,111.5	345.8	258.3	4,713.6	3,229.6	1.5	1,484.0
Reservoir & levee w/selected major bend cutoffs	404.0	304.0	509.0	100.0	1,317.0	1,728.0	1,111.5	345.8	256.5	4,758.8	3,202.4	1.5	1,556.4
Reservoir, levees & channel w/bottom raised 5 feet	367.0	291.0	504.0	100.0	1,262.0	1,728.0	1,111.5	355.5	255.9	4,712.9	3,211.6	1.5	1,501.3
Reservoir only	294.0	176.0	158.0	100.0	728.0	1,728.0	1,111.5	355.6	244.8	4,167.9	2,959.1	1.4	1,208.8
Reservoir & ring levees selective	293.0	272.0	673.0	100.0	1,338.0	1,728.0	1,111.5	343.1	253.3	4,773.9	3,160.1	1.5	1,613.8
Channel only	859.0	867.0	1,292.0	0	3,018.0	0	0	15.9	189.2	3,223.1	1,840.0	1.8	1,383.1
Levee only	535.0	417.0	497.0	0	1,449.0	0	0	5.4	45.8	1,500.2	311.3	4.8	1,188.9
Channel & levees	505.0	393.0	490.0	0	1,388.0	0	0	19.9	45.3	1,453.2	366.3	4.0	1,086.9
Nonstructural													
Fee purchase	0	0	0	0	0	0	370.1	122.1	0	492.2	1,782.[illegible]	0.3	-1,289.8
Restrictive easement	0	0	0	0	0	0	0	0	0	0	1,149.0	0	-1,149.0
Nonrestrictive easement	0	0	0	0	0	0	0	0	0	0	754.0	0	- 754.0
Flood insurance	0	0	0	0	0	0	0	0	0	0	0	0	0
Flood warning & evacuation	0	0	0	0	0	0	0	0	0	0	0	0	0
Combination													
Reservoir w/animal refuge mounds	293.0	176.0	158.0	100.0	727.0	1,728.0	1,111.5	335.6	236.1	4,138.2	2,963.1	1.4	1,175.1
Reservoir & nonrestrictive easement	0	0	0	0	0	1,728.0	1,111.5	335.6	235.7	3,410.8	3,458.1	0.9	- 47.3
Reservoir & restrictive easement	0	0	0	0	0	1,728.0	1,111.5	335.6	235.7	3,410.8	3,696.1	0.9	- 285.3
Reservoir & fee purchase	0	0	0	0	0	1,728.0	1,111.5	433.0	235.7	3,508.2	4,151.1	0.8	- 642.9
Without Project (status quo damages)	965.0	1,287.9	0	0	2,252.9	0	0	0	0	2,252.9	0	0	0

TABLE 2

BENEFIT CATEGORIES AND DESCRIPTIONS OF MEASURES USED TO ESTIMATE THE BENEFITS

Category	Description of Benefits
Flood Control	
Agricultural	Benefits would be derived from the prevention of flood damages to agricultural products and livestock.
Non-agricultural	Benefits would be derived from the prevention of flood damages to fences, roads, bridges, railroads, farm structures, and levees.
Intensification	This benefit would be realized by agricultural producers due to the additional protection afforded the flood plain occupants. This, in turn, would allow for the more intensified and efficient use of these lands. Changes in net income to the agricultural producer was the measure used to estimate these benefits.
Storage Exchange	Benefits are derived from a reduction in the amount of flood control storage required in Wright Patman Lake to provide the same degree of downstream flood protection it now provides without Cooper Lake. This storage space, which would be transferred to Cooper Lake, could then be used for another purpose such as water supply for which there is an expressed need.
Water Supply	These benefits are generated from the cost of the most likely alternative to water supply storage in Cooper Lake that could provide a similar water supply.
Recreation	These benefits would accrue to the increased recreation opportunities afforded by the plan. The benefits were measured based on the expected usage of the facilities provided by the project to meet expected recreation demand.
Fish & Wildlife	These benefits would occur from enhancement, increased hunting and fishing along with the increased production of fish and wildlife offered by the project.
Area Redevelopment	These benefits would result from the hiring of unemployed and underemployed manpower in the construction and subsequent operation of the project.

cow for every 4 acres, amounts to 78 pounds of veal per acre. Based on 1974 normalized prices for the State of Texas* of $46.20 per hundred weight for veal, this amounts to $36.04 per acre. In addition, cull cows and bulls represent an economic yield equal to approximately 20 percent of the calf production or another $7.21 per acre. This results in a total economic yield of $43.25 per acre for the cow-calf enterprise under average management conditions.

Under average management conditions, a typical stocker-calf enterprise involves purchase of calves at 400 pounds which are subsequently sold at 650 pounds. Based on the 4 percent death loss and 1.25 animals per acre, the total gain in weight per acre amounts to 280 pounds with the resulting economic yield of $129.36 per acre.

Under advanced management conditions, a cow-calf enterprise with one cow for every two acres and a weaned calf crop of 90 percent with an average calf weight of 500 pounds yields 225 pounds per acre, or $103.95 per acre returned on calf production. In addition, cull cows and bulls produce a yield of about 14 percent of the calf production or an additional $14.55 per acre resulting in the total economic return of $118.50 per acre. In the case of stocker-calf enterprise under advanced management in which calves are stocked at 400 pounds and sold at 700 pounds and experience only a 2 percent death loss, the average yield is 572 pounds per acre resulting in an economic return of $264.26 per acre.

Typical land utilization for pasture within the Sulphur River Valley bottom involves approximately 20 percent under advanced management and 80 percent under average management with 30 percent of each category in stocker-calf enterprises and 70 percent in cow-calf enterprises. Accordingly, the weighted average economic return per acre has been computed as follows:

Cow calf advanced	= 0.70 x 0.20 x $118.50	= $16.59
Cow-calf average	= 0.70 x 0.80 x $ 43.25	= $24.22
Stocker-calf advanced	= 0.30 x 0.20 x $264.26	= $15.86
Stocker-calf average	= 0.30 x 0.80 x $129.36	= $31.05
Weighted Average Economic Return per Acre		= $87.72

Agricultural damages. The weighted average return of $87.72 per acre represents the economic potential of Sulphur River bottomland. In evaluating the damages associated with flooding, the basic procedure has been to ascertain the extent of damage that would have occurred under the historic flood series to the area in pasture and semi-wooded land uses. The mechanics of this procedure involved developing stage-area curves which relate land area inundated throughout the Sulphur River bottom to the stage at the Hagansport gage. These curves were

*Taken from U.S. Water Resources Council Guidelines for "Agricultural Price Standards for Water and Related Land Resources Planning" dated February 1974.

developed by considering the backwater profiles under various levels of flow up to the 30-year flood and ascertaining those lands which would be inundated at each level of flow. These curves were then utilized in conjunction with the historic flood series from 1945 through 1971 inclusive to determine the total area of cleared land and semi-wooded land inundated for each of the floods in this series. Damage has been evaluated by reference to pasture damage curves for an alluvial valley prepared in 1958 by the U.S. Army Corps of Engineers which expresses damage due to inaccessibility and to stand, by season of year and duration of flooding, as a percent of gross profit. A copy of these curves is included in Exhibit 4 in the back of this appendix, and since all values of damage are expressed in percent, the curves are considered valid and independent of current price data or changes which have occurred since the curves were prepared in 1958.

The use of the pasture damage curve, reflected in the tabulated flood series, indicates the percent damage occurring in terms of lost grazing and in terms of percent of stand. The production loss per acre is expressed in dollars and is arrived at by multiplying the total percent of loss against the $87.72 average potential profit per acre developed as above. The basic philosophy involved is that the potential profit which is gained by virtue of cattle operations is established from the utilization of pasture. A loss in grazing time or damage to pasture stand will be proportionate to a reduction in the rate of weight increase of cattle and this decrease in weight may be prevented in spite of flood damage by importing of grains to feed cattle evacuated to higher land. An economic loss is nevertheless realized and is felt by the individual farmer in terms of the cost of evacuating cattle and purchasing of additional feed grains. In terms of loss to the economy, however, the most valid measure is in terms of the damage to the pasture which would normally be expected to support these cattle. Since the economic return from this pastureland is realized through the marketing of beef, the fairest measure of value of this pasture is in terms of the potential gain of weight to the cattle involved and the best measure of damage is reflected in the loss of the weight that the cattle would be expected to experience were they not sustained by supplementary feeding.

No specific credit has been taken in computing damages for the loss of life to cattle through drowning. It is recognized that loss of cattle through drowning has been experienced in the past. However, the extent of loss of life to cattle is highly indeterminate and can only be indicated by historical experience which reflects a relatively low degree in comparison to all other flood associated losses. For example, during the extremely heavy flooding period from October to December 1971, damage surveys by the U.S. Army Corps of Engineers, as summarized in a letter of May 19, 1972 (New Orleans District), indicated that nearly 400 head of cattle were lost within an area of inundation approximately 152,000 acres. This amounts to about one head of cattle for every 380 acres of land which would represent a loss of less than $1.00

per acre even under very severe flooding conditions experienced at that time, which greatly exceeded the 30-year design flood being considered herein. Accordingly, drowning losses have been neglected, except to the extent that they might be considered indirectly reflected in the death loss percentages utilized above in computing weighted average economic return per acre. Benefits for agricultural damages reduction for each alternative in the final EIS were calculated based on the area protected from flooding by the placement of various flood control works associated with each alternative under consideration.

Non-agricultural damages. In the floods from October to December 1971 and typically in other historical floods, heavy damages have been sustained to fences and to existing levees which have been either overtopped or ruptured at points of weakness, and other minor non-agricultural damage has been sustained by farm equipment left in low fields or from such causes as shoaling in drainage ditches and stock ponds. The largest single loss has been sustained by fences which are torn out by floating debris carried downstream by flood waters. Much of this floating debris consists of cleared timber that has been stacked in windrows to dry prior to burning. Consequently, the extent of damage which might be anticipated is highly indeterminate since it is not a function of hydrologic phenomena. Similarly, damage to levees through crevassing is difficult to project since the damage sustained is not only a function of magnitude of flood but relates to level of maintenance and to non-predictable factors such as extensive weakening due to burrowing of small animals within the levees.

In an effort to arrive at a fair basis for evaluating non-agricultural damage, consideration has been given to the damage surveys by the U.S. Army Corps of Engineers as reported in letter of May 1972 relative to the floods of October to December 1971. While this report covered a wider area than that under immediate consideration, it did set forth specific figures relative to the South Sulphur River and the main stem of the Sulphur River below the confluence of the North and South Sulphur Rivers. Damages in this area have been updated to July 1974 prices and are presented in the following tabulation.

Item	South Sulphur River	Sulphur River
Fences	$496,000	$527,500
Roads and bridges	21,800	22,900
Levees	306,000	618,800
Other	12,400	0
Total	$836,200	$1,169,200

The total non-agricultural damages, consisting of $836,200 for the South Sulphur River and $1,169,200 for the Sulphur River below Cooper Dam, amount to $2,005,400 for the area inundated by the floods of October to December 1971, totaling 111,900 acres within these two reaches. While the damage sustained was probably heavier in the cleared and semi-wooded areas by virtue of more extensive fencing in these areas, damage was also sustained in wooded areas particularly where levees

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were involved and in areas of road crossings. For the purpose of this analysis, it has been assumed that a fair parameter to use as an index of non-agricultural damage would be the average damage per acre considering all land subject to inundation whether clear, semi-wooded, or wooded as determined by the damage survey for the October-December 1971 floods. This results in a non-agricultural damage figure of $17.92 per acre. Non-agricultural damages were then estimated by applying this $17.92 per acre figure to the average area of land inundated, including wooded land, by the historic flood series. Benefits for non-agricultural damages were calculated for each alternative based on the acreage of land protected by the placement of flood control works associated with each alternative.

Intensification benefits. The MO stated that "witnesses for the Corps based the estimated benefits upon their predictions that the project would include a conversion from pasture and woodlands to row crops." The 1974 flood control benefits credited in the final EIS filed 24 June 1977 were composed of agricultural, non-agricultural, intensification, and storage exchange benefits. Each type of benefit was briefly described in table 2. Agricultural, non-agricultural, and storage exchange benefits were based upon existing conditions and damages and benefits that could occur within the flood plain above and below Wright Patman Reservoir. No conversions of land use to suburban or urban activities or future damages and benefits were claimed for the above benefit categories. However, intensification benefits did contain a conversion of wooded lands to primarily hay and pasture production. The following paragraphs explain the rationale of these benefits.

In the 1974 analysis, information on changes in land use, crop yields, cost of production, and ongoing woodland conversions were secured through field interviews with County Agents, the Soil Conservation Service, and flood plain landowners as well as data derived by the U.S. Department of Agriculture for the Texas Crop and Livestock Reporting Service. Future land conversions applied in the benefit analysis were based on expected demand for increased agricultural production, soil types, and capabilities within the present floodways, topography, size of woodland plots, and the relative elevation of the land surface.

Analysis of the above factors resulted in an assumption that about 80 percent of the wooded acres protected would be converted to cleared and semi-wooded pasturelands. It was estimated that about 15 percent of the usable protected area would be converted to hay production. The woodland areas converted were assumed to occur at a uniform rate over a 10-year period following completion of a given flood control plan being evaluated. The lands converted were assumed to be in the same proportion as presently exists within the protected areas. The remaining 20 percent of the wooded area was classified as non-usable due to periodic backwater flows around open ends of the levee systems and the areas required for sumps or drainage facilities.

Intensification benefits for improvements were then based upon the changed land use at a period beginning 10 years after project construction, and claiming the difference in potential net income with the new land use as compared to the land use without a project.

Aerial photography taken in 1972 along with available USGS topographic maps were used to identify land uses for the 1974 benefit analysis. Field investigations, including numerous on-site inspections and a helicopter over flight, conducted by Forrest and Cotton, consultants, confirmed a continuing transition from row crops to grazing use on developed flood plain lands. This trend to pasture use had been observed at least since 1967, and based on the 1974 field surveys, it was determined that the developed areas in the Sulphur River flood plain, which once had substantial cropland, had been converted back to pasturelands for grazing purposes.

Lands within the flood plain of the Sulphur River have undergone reclamation through flood protection and drainage improvements for many years. Levee and channel improvements constructed in the 1950's and earlier have caused a conversion of wooded land to cleared lands as can readily be observed with available aerial photography. The rate of land conversion in newly protected areas and the types of new agricultural activities adopted depend on a number of variables, including prevailing market conditions for different agricultural products, availability of financing, cost of land clearing and preparation, and individual agricultural producers preferences and capabilities.

Soils in the flood plain consist almost entirely of Trinity and Kaufman clays. Review of soil surveys published for counties in the Sulphur River basin show these soils to have high potential for row crops and for pasture and hay. Production potentials for grain sorghum and soybeans listed in Delta, Lamar, and Red River county soil surveys are higher for Trinity and Kaufman clays than for any other soil types found in the area.

These soils are somewhat poorly drained, with high water holding capacity. Runoff is slow, and the erosion hazard is slight since the soils are nearly level, except in areas subject to streambank sloughing. With levee protection, these soils are rarely flooded during the warm season. The seasonal high water table is at a depth less than 3 feet, the soils dry slowly in spring which can delay cultivation, and the clayey nature makes them somewhat difficult to work. Unleveed areas are suited mainly for pasture and hay, with tall fescue, Johnson grass, white clover, and singletary peas also well suited.

Trends for Sulphur River basin county land uses in the United States Census of Agriculture also confirmed a general downward trend in acreages devoted to cropland and woodland and an increase in pasture acreages, prior to 1974. Therefore, the 1974 existing use of the protected Sulphur River 30-year flood plain for the purpose of

evaluating future intensification benefits was determined for the final EIS recommended plan (Reservoir and Levees) to include 11,900 wooded acres of which 9,520 were estimated to be converted to semi-cleared, cleared, and hay. In 1974, a small amount of acreage was dedicated to row crops, however, trends indicated that this practice would continue dimishing in future years. Accordingly, over the period of analysis, no row cropland was included in the benefit analysis. Some interpretations consider hay production as row cropland; this was not the case in this study. The 1974 pasture land use category was considered to be in coastal Bermuda grass which was used for grazing purposes rather than hay production.

Examination of historical land use trends within the major levee systems existing in the Sulphur River flood plain (5RSS and 1RS) resulted in the development of a number of assumptions on anticipated land conversion trends and rates of intensification. Based on information on existing levee improvements included in the 1958 General Design Memorandum for the Downstream Levees and Channels, these levees protected a total of 12,014 acres of which about 2,155 acres had been cleared at that time. Aerial photography taken in 1955 shows most of the cleared area in pasture, with about 1,300 acres being cleared at that time. The 1972 aerial photography shows about 8,500 acres in pasture use, with the remainder of the protected area in wooded use. Most of the land conversion from wooded to cleared acreages occurred between 1955 and 1964. Very little land conversion or new levee and channel improvement work was apparently done in the Sulphur River flood plain between 1964 and 1974. Since 1974, one tract of wooded land consisting of about 1,800 acres partially protected by levee 3RS and partially unprotected has been completely cleared and put into crop production. Sorghum and rice are currently farmed on this tract. At least two other landowners are known to be actively pursuing levee improvement projects and clearing of Sulphur River bottomlands for row crop production. Some of these proposed projects follow levee alignments included in the Cooper Lake and Channels Authorization. It is apparent that given a favorable economic climate and adequate flood protection, the landowner would opt for intensification of land use in the Sulphur River flood plain.

New aerial photography taken in March and April of 1980 and verified by interviews with agricultural producers behind levee 5RSS and 1RS show about 9,500 acres in this protected area are in row cropland use. Soybeans, wheat, and sorghum are the primary products grown. About 2,500 acres of the protected area remained wooded in 1980 but are scheduled for further clearing. Conversion of these lands from pasture to row crops occurred between 1977 and 1980. About 1,500 to 1,800 acres of the cleared land remain subject to periodic flooding by the open end levee design, and the entire protected area is subject to flooding from the 30-year frequency flood events and greater.

Based on the historical development of flood plain lands for agricultural use in the Sulphur River basin, the type of soils present,

and land use trends and private actions, the predicted intensification of flood plain lands, with structural protection from flooding was supportable in the 1974 analysis, and is still supportable. The potential high productivity of Sulphur River bottomland soils is one of the main reasons for conversion providing the proper economic incentives exist. It is readily apparent that, given a favorable economic climate which will support intensification of land use by the private landowner along with publicly funded or assisted structural projects to reduce flood hazards, the landowner will pursue the conversion. Whether row crops or pasture is the new use depends on other factors at play in the basin, such as recent changes in land ownership, the tendency of individual landowner to continue to operate their lands in the manner they have done for years (i.e., farming as opposed to ranching or dairy farming) and capital investment required to convert from one operation to another, etc.

Storage exchange benefits. Construction of Cooper Lake will permit the conversion of 120,000 acre-feet of the 2,509,000 acre-feet flood control storage in Wright Patman Lake to water supply. Since Cooper Lake is upstream of Wright Patman, its 131,400 acre-feet of flood control storage will substitute for 120,000 acre-feet in Wright Patman so the level of flood protection below Wright Patman will not be impaired. The final EIS notes that completion of Cooper Lake only makes possible the conversion of storage at Wright Patman. The conversion is not mandated by the authorization for Cooper Lake; it is, however, permitted by that legislation. The decision is a future determination and an EIS will be prepared prior to implementation. Cooper Lake is independently justified and could be implemented irrespective of whether the storage is converted. The amount was determined by establishing a ratio between the volume converted and the existing total flood control capacity of Wright Patman. This ratio was applied to total flood control benefits attributable to Wright Patman. In the March 1975 Alternative Plan Studies and in GDM No. 2-B, Supplement No. 1, revised June 1977, $100,000 average annual benefits for the conversion (July 1974 price level) were claimed as benefits for flood control downstream of Wright Patman which will be preserved by flood control storage in Cooper Lake

Water Supply Benefits

The benefit for municipal and industrial (M&I) water supply is based on the cost of the most likely alternative to water supply storage in the multiple-purpose project, which is a single-purpose water supply reservoir at the Cooper site. The average annual benefit for municipal and industrial water supply is computed as the annual charge for the most likely alternative project, a non-Federally financed, single-purpose reservoir at the Cooper site yielding 109.0 mgd. This benefit was computed in the General Design Memorandum (GDM) No. 2-B,

dated June 1967, to be $714,000, based on an alternative to supply 96.2 mgd. The M&I storage was subsequently increased to provide a yield of 109 mgd in 1968. The water supply benefit for this storage was computed as follows:

Cost of Alternative to supply 109 mgd	$22,360,000
Interest during construction (4-yr const @ 4.0%)	1,788,800
Gross Investment	$24,148,800
Assuming a bonding period of 25 yrs @ 4% the annual payment is: $24,148,800 x 0.06401 =	$ 1,545,765
The required equivalent Federal investment @ 3-1/4% over 25 yrs would be $1,545,765 x 16.93786 =	$26,181,951
Amortized over the 100-yr life of the project @ 3-1/4% is: $26,181,951 x 0.03388 =	$ 887,044
Annual O&M and Replacements	$ 89,000
Average annual M&I Water Supply Benefit	$ 976,044
(Rounded)	$ 976,000

Through a succession of price indexings over the period July 1968 to July 1974, the water supply benefit increased to $1,728,000. This was the water supply benefit claimed for each alternative evaluated in the final EIS containing a multi-purpose reservoir feature.

Area Redevelopment Benefits

Area redevelopment benefits for the Reservoir and Levees plan (final EIS) were computed as follows. The project lies in or within commuting distance to 14 Texas counties, 9 of which were qualified as Title IV redevelopment areas under the Public Works and Economic Development Act of 1965, as amended.

County	Criteria for Qualification
Bowie	8
Camp	8
Cass	8
Delta	2
Fannin	8
Franklin	-
Hopkins	-
Hunt	-
Lamar	8
Morris	8
Rains	2,8
Red River	2.8
Titus	-
Wood	-

(2) - Low median family income
(8) - Substantial unemployment

It was anticipated that the underemployed labor resources of the area would be sufficient to meet the labor demands for construction. Labor expenditures were estimated to represent 27 percent of total construction expenditures; 57 percent of these labor charges would be expended on otherwise underemployed labor. Furthermore, it is expected that the supply of underemployed labor resources available for O&M requirements would steadily decline to zero over the next 20 years. O&M labor expenditures were estimated to represent 38 percent of total expenditures; 65 percent of O&M labor charges would be initially expended on otherwise underemployed labor. Average annual area redevelopment benefits attributable to construction and O&M expenditures were computed by amortizinn over 100 years at 3-1/4 percent.

Reservoir & Levees Recommended Plan
in Final EIS

Construction Expenditures
$41,397250 x .27 = $11,177,257 x .57 = $6,371,036 x
.03388 = $215,900

O&M Expenditures
$561,400 x .38 = $213,332 x .65 = $138,666 ÷ 20 x
168.02012 x .03388 = $39,500

Total Area Redevelopment Benefit = $255,000 (rounded)

Area redevelopment benefits were calculated similarly for the other 22 alternatives evaluated in the final EIS.

Clarification of Recreation, Fish and Wildlife Benefits

Introduction. In the Memorandum Opinion issued December 8, 1978 outlining deficiencies of the final EIS for the Cooper Lake and Channels project, several points were raised regarding the validity of the benefit/cost ratios developed for the alternatives due to questions on the proper values to be used for calculating recreation benefits and charges. These points or issues to be clarified by the Corps included the following:

a. Crediting the project with flatwater recreation benefits and placing a low value on hunting recreation losses demonstrated a bias in calculating the benefit/cost ratio.

b. Flatwater recreation benefits may be a double counting of a surplus commodity, since other lakes are nearby.

c. Principles and Standards (P&S) should be used in calculating recreation benefits and losses.

In order to test the sensitivity of the monetary benefits and the monetary losses of fish and wildlife resources attributed to each alternative now under consideration, recreation gains and losses are presented based both on guidance in effect for the Cooper project and Principles and Standards (P&S)

Discussion. The provisions of P&S for determining the unit value which should be placed on recreation associated benefits (including sport fishing and hunting) are nearly identical to Supplement 1 to Senate Document 97, differing primarily in the range of values from which the agency selects an appropriate dollar amount per man-day for a specific project under study. Values used for evaluating benefits and losses of the 23 alternatives considered for the Cooper Lake and Channels project were derived from Supplement 1 to Senate Document 97. Applicability of the P&S is as follows:

"The Principles and Standards will apply to all levels of planning studies. For authorized but unfunded projects, the Principles and Standards will be applied on a selective basis to be determined by the head of the agency, with opportunity for suggestions from the Water Resources Council, and other governmental entities. Authorized plans or projects that are substantially reformulated as a result of application of these P&S will be submitted to Congress for reauthorization. Separable and independent elements of a project or a system also would be subject to review prior to funding for construction." Principles and Standards for Planning Water and Related Land Resources, 38 Fed. Reg. 24778, 24791 (1973). In Corps regulations developed pursuant to publishing of P&S, this discretionary authority was expressed as follows:

"For projects authorized prior to 25 October 1973, Senate Document 97 and Supplement No. 1 are applicable to Phase 2 studies. However, projects authorized prior to 25 October 1973, for which construction has not been initiated, may be reevaluated under the WRC Principles and Standards, if determined appropriate by the Secretary of the Army...."

The Cooper Lake project, authorized in 1955, PL 84-218, and funded since 1957, falls within the series of projects outside of the coverage of P&S and consequently the project was not evaluated under them. Therefore, under Corps guidance in effect at the time, reflecting the discretionary authority of the Corps to implement P&S, and the authorization date of the Cooper Lake and Channels project, the range of values from Supplement 1 were appropriate. In evaluating monetary wildlife and fishery losses, the Corps established first the quantity in man-day use which would be expected to be lost for each alternative under consideration. The quantity lost was calculated for categories of sport fishing, sport hunting, and wildlife oriented recreation, by relating the acreage of habitat modified or lost by each alternative to the potential man-days per acre attributable to that habitat.

Commercial fishery and commercial trapping losses were calculated in the same manner. These man-day/acre relationships were calculated from published data provided by the US Fish and Wildlife Service and the Texas Parks and Wildlife Department. A monetary value of $1.50/man-day of sport fishing, $6.00/man-day of big game hunting, $2.00/man-day of small game hunting, $1.50/man-day for wildlife oriented recreation, and $6.00/man-day of waterfowl hunting was established by the Corps. While these values may seem low, they were the highest values allowed within the range provided by Supplement 1 for calculating monetary wildlife and fishery losses and represent a net "willingness to pay" for the recreation experience above the cost of the experience. The same monetary values were used by the Corps in calculating benefits derived from estimated increases in surface fishing at Cooper Lake and from fishing, hunting, and wildlife oriented recreation on created cut-off oxbows which were features of some plans. The results of these calculations were presented in tables IV-2, IV-3, IV-4, IV-5, VI-2, and VI-3 of the final EIS.

Computations of general recreational use expected at the proposed Cooper Lake were made by developing a per capita use curve for various distance zones around the lake, based on actual recorded use at two similar projects (Lewisville Lake and Whitney Lake), and applying this to populations and per capita use estimates within these zones. The per capita use curve automatically takes into consideration competition from other lakes in the area of the similar project, since the visitation records are actual use. For example, actual recorded visitation at Lake Whitney occurred despite competing use from Waco, Bardwell, Navarro Mills, Belton, Stillhouse Hollow, Proctor, Benbrook, and several non-Federal lakes within 100 miles of the dam.

The following is a summary of the general recreation analysis presented in the draft EIS filed 10 June 1976.

Recreation Benefit Analysis - 1974 Conditions

Outdoor recreation attendance. Estimated initial and projected general outdoor recreation visitation to Cooper Lake was calculated using the procedures specified in Engineering Regulation 1120-2-403 "Estimating Initial Reservoir Recreation Use," prepared by the US Army Engineer District, Sacramento, California, for the Office, Chief of Engineers, Department of the Army (1969). The procedure utilizes the "most similar project" conception, an existing lake(s) that is (are) most comparable in size, operation, and anticipated recreation-use characteristics. This procedure relates recreation-use information from an existing lake to the lake under study and provides the basis for the use-estimating technique.

Market area. The day-use market area evaluation of Cooper Lake, as outlined in ER 1120-2-403, requires that the area surrounding the

proposed project be divided into road-mile distance zones. Zones 1 through 5 are each 10 miles wide and zones 6 and 7 are each 25 miles wide. These zones were determined by measuring road mile distances along major and secondary access routes from the center of population of the surrounding counties to the Cooper Reservoir damsite. Generally, the most populated city represents the center of population for each county with the exception of Hunt county which contains two equally populated centers. Road-mile distances from the center of population to the project site was measured, and the county this center represents was placed into one of the seven distance zones. The counties within each zone are as follows:

ZONES						
1	2	3	4	5	6	7
(Road Miles)						
(0-10)	(11-20)	(21-30)	(31-40)	(41-50)	(51-75)	(76-100)
Counties*						
Delta	Hopkins	Lamar	Hunt (Greenville TX)	Franklin	Red River	Kaufman
	Hunt (Commerce, TX)		Rains	Wood	Rockwall	Upshur
					Choctaw*	Smith
					Titus	McCurtain*
					Fannin	Henderson
					VanZandt	Bryan*
					Camp	Dallas
					Collin	Denton
					Morris	Gregg
					Pushmataha*	Marion
					Grayson	Cooke

* Oklahoma counties; all other counties are in Texas

Use rates. Per capita use-rates applicable to the counties which comprise the seven distance zones were derived by comparing the proposed project with two comparable Corps of Engineers lakes, Whitney and Garza-Little Elm, Texas. Recreation per capita use-rates for the two similar projects as given in ER 1120-2-403, Appendix B, were empirically modified and adjusted on the basis of geographical location, attendance figures, population densities, and physical characteristics to obtain single per capita use rates applicable to each distance zone around Cooper Lake. The per capita use-rate applicable to each distance zone is multiplied by the total population of the county or counties which comprise each zone to yield the annual day use.

Anticipated visitation. Estimated day use is shown for the initial year of development. Camping, in addition to total day use, is estimated to comprise 18 percent of the total use at Cooper Lake. This

gives an estimated annual use of 1,508,000 visitors. A future increase in visitation is not anticipated because the proposed recreation facility development will support only the estimated initial use.

COMPUTATION OF INITIAL DAY-USE AND TOTAL USE COOPER LAKE

Zone	User Distance From Lake	Zonal Populations (1980) 1/	Per Capita Use Rate 2/	Day-Use
1	0-10	5,200	30.00	156,000
2	11-20	42,800	7.40	316,720
3	21-30	38,000	2.50	95,000
4	31-40	37,900	1.40	53,060
5	41-50	26,800	0.70	18,760
6	51-75	301,100	0.48	144,528
7	76-100	1,975,100	0.25	493,775
			Day use	1,277,843
			Camping (18%) 3/	230,011
			Total use	1,507,854
			Rounded	1,508,000

Notes:

1/ Based on disaggregation of projections of water resource sub-areas. US Water Resource Council, <u>1972 OBERS Projections</u>, <u>Series E</u>, April 1974

2/ Derived from ER 1120-2-403, Estimating Initial Reservoirs Recreation Use, Appendix B. Projects: Garza-Little Elm and Whitney Reservoirs, Texas. Rates are day-use only.

3/ Based on recreation-use data summaries in ER 1120-2-403; it is estimated that camping will comprise 18 percent of the initial total use of Cooper Lake. Per capita use rates yield day-use visitors only.

<u>Determination of unit value</u>. The determination of a value for general recreation use within the $0.[illegible]0-$1.[illegible] range provided in Supplement 1 to Senate Document 97, is based on the quality and variety of the recreational resource provided and its relationship to other existing and competing recreation resources within the area. This determination is largely judgmental based on a number of criteria which try to relate the recreation experience provided with the quality and quantity of similar recreation experiences elsewhere. For Cooper Lake, initial Federal development would be provided in two park areas, with excellent public access to all remaining project lands, and a variety of quality facilities provided for day use and camping experiences. Federally operated projects are suitable for multiple use activities, and relatively large areas of land are available for public use in comparison with local or state operated facilities. The park areas to be developed have highly esthetic characteristics in comparison to most

of the surrounding lands which are in crop production. All water areas will be suitable for boating, water skiing, and surface water fishing, and access will be provided to a tailwater fishery. The two parks to be developed are situated on sloping ground so that effects of flood pool rises and drawdowns will be minimized. There are no competing state parks or surface water lakes with large scale public recreation development within a 25-mile radius of Cooper Lake, and competing lakes within a 50-mile radius provide only limited development, with the exception of Pat Mayse and Lavon Lakes (40 and 50 airline miles from the damsite, respectively). Based on these factors, the full $1.50/man-day benefit value for general recreation is assigned to the visitation estimates for Cooper Lake. Applying this general recreation day value of $1.50 would result in an annual benefit of $2,262,000 for the project.

These computations resulted in an average annual visitation estimate of 1,508,000 which was used for determining general recreation (excluding hunting and fishing) benefits for the reservoir in the draft EIS.

Since benefits claimed previously for general recreation at Cooper Lake were calculated only for 741,000 visitors annually, and the higher number had not been approved formally at the time of the final EIS, the Corps used the lower visitation for the purpose of determining benefits in the final EIS for alternatives including a multipurpose reservoir at the Cooper site.

The 1,508,000 annual general visitation estimate was based on Corps regulations and guidance in effect for the Cooper Lake study and is a valid initial visitation estimate for the 1974 base year analysis. Earlier recreation use studies done prior to publishing the draft EIS for Cooper had developed an initial recreation use estimate of 741,000 man-days of general recreation annually. This estimate evolved from earlier studies utilizing 1960 population data and demand projections, a staged initial and ultimate pool for Cooper Lake, and consideration of competition from other proposed lakes in the area in the Texas Water Plan including Big Pine Lake, Sulphur Bluff I and II, and Naples I and II. None of these lakes have been constructed. Since recreational benefits derived from these studies were more than adequate to justify the proposed recreation development, and were approved, the Corps used the earlier estimate for the purpose of estimating surface water related (day use and camping) benefits for Cooper Lake. In fact, no recreation benefits were needed to justify the remaining project purposes, and recreation could be deleted as a project purpose leaving a still economically viable flood control and water supply project.

<u>Analysis by Principles and Standards</u>. Principles and Standards (P&S) provides a range of values from $0.75 to $2.25/man-day for general recreation and $3.00 to $9.00 for special or limited opportunity recreation. Higher values are permissible if a full explanation and

justification for their use is given. For the purpose of this sensitivity analysis, the high range of these values is considered to be $9.00 for stream fishing (including oxbows), big-game, waterfowl and small game hunting, and wildlife oriented recreation. These could be considered to be specialized forms of recreation due to the private ownership of most land in Texas and the lack of public opportunities to participate freely in these pursuits. For comparison of benefits attributable to the multipurpose Cooper Lake feature of considered alternatives, based on P&S, the low range value, high range value, and no value for general recreation were applied to the normal range of lake water oriented recreation expected (camping, lake fishing, water skiing, picnicking). A $3.00 per man-day low value, a $6.00 per man-day high value, and no value was used for comparison of benefits claimed for waterfowl hunting on the lake. Commercial wildlife and fishery benefits and losses for the lake and downstream areas affected by various alternatives are not based on either P&S or Supplement 1 to Senate Document 97. These values are therefore kept constant. The results of these changes in dollar values for benefits claimed in the 1974 analysis for Cooper Lake are displayed in table 3.

This table was modified from Table IV-2 of the final EIS. Using values from these tables, an analysis can be made to test the sensitivity of using different assumptions on appropriate values to be used. Results of this analysis are summarized in table 4. First the wildlife and fishery benefits (including oxbows where applicable), recreation benefits, total benefits, wildlife and fishery losses, and total charges on an average annual basis are presented for the reservoir and levees alternative. Wildlife and fishery losses are based on total man-day of various hunting and fishing potential opportunity lost due to loss of habitat. This is the same data as presented in the final EIS based on values from Supplement 1 to Senate Document 97. To test the first point listed in the introduction on page C-14, the total wildlife and fishery losses based on the highest allowable P&S value for the total man-days lost were substituted in the annual charges for this alternative, and the total lake recreation benefits based on the lowest P&S value were substituted for the annual benefits claimed. High P&S values were retained for the small amount of wildlife and fishery benefits attributed to oxbows in the Reservoir and Levees alternative as this is also considered a specialized form of recreation. No changes were made to the other annual charges or annual benefits developed for flood control, water supply, or redevelopment. To test the second point in the introduction, the total wildlife and fishery losses based on the highest P&S values were retained as an annual charge. No benefits are assumed for lake recreation including fishing and waterfowl hunting, even though this estimated use is supported by Corps analysis. Since no benefits are claimed, recreation as a purpose of the lake was assumed to be deleted, and the annual charges for the reservoir were reduced by the costs attributed to this purpose ($2,083,000 in initial cost of facilities and $104,150 in annual operation and maintenance). For comparison,

TABLE 3

RECREATION, WILDLIFE, AND FISHERY BENEFITS FROM THE LAKE 1/

Category	Gains 2/	Values (Dollars)			
		Final EIS (S.D. 97) 3/	P&S Low Value 4/	P&S High Value 5/	No Benefits 6/
Sport Fishing	174,000 man-days	261,000	130,500	391,500	0
Commercial Food Fishing	139,200 lbs	34,800	34,800	34,800	34,800
Commercial Non-Food Fish	278,400 lbs	13,920	13,920	13,920	13,920
Waterfowl Hunting	4,315 man-days	25,890	12,945	38,835	0
General Recreation	741,000 man-days	1,111,500	555,750	1,667,250	0
Totals		1,447,110	747,915	2,146,305	48,720

1/ All figures are based on an average water surface area of 17,400 acres.

2/ 10 man-days/acre - potential sport fishing; 8 lbs/acre - potential commercial flood fish harvest; 16 lbs/acre - potential commercial non-food fish harvest; 0.248 man-day/acre - potential waterfowl hunting.

3/ $1.50/man-day - value of sport fishing; $0.25/lb average commerical food fish value; $0.05/lb average commercial non-food fish value; $6.00/man-day value of waterfowl hunting; $1.50/man-day value of general recreation

4/ $0.75 for lake fishing; $3 for waterfowl, $0.75 for general recreation

5/ $2.25 for lake fishing, $9 for waterfowl, $2.25 for general recreation

6/ No benefits claimed due to assumed surplus of lake-type recreation, i.e., no new demand. This is not a valid assumption based on use projections for Cooper Lake conducted by the Corps of Engineers.

and partially to address the third point above, total wildlife and fishery losses based on the highest P&S values, and total lake and oxbow recreation benefits based on the highest P&S values were also substituted in the analysis for each alternative. It can be seen from table 4 that regardless of the values used within the range provided (P&S or Senate Document 97) and the varying of assumptions on the appropriate value to be assigned to monetary losses and benefits attributable to changes in man-day use as a result of the Reservoir and Levees alternative, the total benefit/cost ratio for each analysis remains positive.

In a letter dated July 24, 1978, to the Lafayette Field Office of the US Fish and Wildlife Service, the Texas Parks and Wildlife Department (TPWD) provided an analysis of Corps of Engineers estimates for man-days of use and values as displayed in Table IV-4 of the final EIS for the Cooper Lake and Channels project. In that letter, the TPWD verified estimates of 174,000 reservoir days of fishing gained with Cooper Reservoir and 13,000 stream days on the Sulphur River in the without project condition. The TPWD provided an estimate of $8 per man-day of fishing as compared to the $1.50 used by the Corps. Using the $8 value for both fishery losses and gains, the net increase in fishing monetary benefits would be substantial although the type of fishing would be shifted to lake-oriented fishing, with only small increase in monetary charges to the project from losses in stream fishing.

The TPWD also stated the Corps estimates of values per man-day of use were too low. The TPWD did not furnish a set value per man-day, but suggested several methods of calculating higher values based on fees charged by landowners, entrance fees paid for State hunting areas, lease fees for hunting clubs, and the 1974 Economic Survey of Wildlife Recreation conducted by Georgia State University. The TPWD referenced previous estimates of values provided to the Fort Worth District in 1975 of $25-42 for big game hunting, $20 for waterfowl, and $5-10 for small game. These values represent the actual costs of hunting and do not represent a net "willingness to pay" for the particular recreation activity. Even if the high range of these values are substituted for the man-day losses for these types of hunting, $9 per man-day is used for losses of wildlife-oriented recreation and low values of $1.50 per man-day for lake and oxbow fishing, $6.00 per man-day of waterfowl hunting, and $1.50 per man-day of general recreation, are retained for benefit calculations, the recommended plan in the final EIS (Reservoir and Levees) would still retain a favorable benefit to cost ratio. This is shown in table 5.

TABLE 4

SENSITIVITY OF BENEFIT/COST RATIO TO VARIOUS RANGES OF VALUES USED FOR WILDLIFE, FISHERY, AND GENERAL RECREATION GAINS & LOSSES

	Reservoir & Levees Alternative (1974 Analysis)
1. Range of Values From Supplement 1 to SD 97 (FEIS)	
a. Total Fish & Wildlife Monetary Losses	- 54,100
b. Total Annual Charges	3,178,100
c. Lake General Recreation Benefits	+1,111,500
d. Fish & Wildlife Monetary Gains	+ 341,010
e. Total Annual Project Benefits	4,727,510
f. Benefit/Cost Ratio	1.5
2. Low P&S Value For Lake Recreation, Including Fishing, and High P&S Value for Oxbow Gains and Fish & Wildlife Losses	
a. Total Fish & Wildlife Monetary Losses	- 194,335
b. Total Annual Charges	3,318,335
c. Lake General Recreation Benefits	+ 555,750
d. Fish and Wildlife Monetary Gains	+ 221,397
e. Total Annual Project Benefits	4,052,147
f. Benefit/Cost Ratio	1.2
3. P&S High Values for All Recreation, Fish & Wildlife Gains and Losses	
a. Total Fish & Wildlife Monetary Losses	- 194,335
b. Total Annual Charges	3,318,335
c. Lake General Recreation Benefits	+1,667,250
d. Fish & Wildlife Monetary Gains	+ 508,287
e. Total Annual Project Benefits	5,450,537
f. Benefit/Cost Ratio	1.6
4. No Benefits for Lake Recreation, Sport Fishing, or Sport Hunting. P&S High Values Used for Fish & Wildlife Losses & Oxbow Gains	
a. Total Fish & Wildlife Monetary Losses	- 194,335
b. Total Annual Charges	3,143,129
c. Lake General Recreation Benefits	0
d. Fish & Wildlife Monetary Gains	+ 77,952
e. Total Annual Project Benefits	3,352,952
f. Benefit/Cost Ratio	1.1

Note: All benefits and charges other than recreation, fish and wildlife remain constant in the above analysis.

TABLE 5

BENEFIT/COST ANALYSIS OF (FEIS) RECOMMENDED PLAN
USING TPWD HIGH RANGE VALUES

Total Fish and Wildlife Losses 1/	$ 274,327
Total Annual Charges	3,398,327
Recreation Benefits of Lake 2/	1,111,500
Fish and Wildlife Benefits 3/	341,010
Total Benefits	4,727,510
Benefit to Cost Ratio	1.4

Notes:

1/ $42.00 per man-day of big game hunting, $20.00 per man-day of waterfowl hunting, $10.00 per man-day of small game hunting, $9.00 per man-day wildlife recreation, $9.00 per man-day stream fish, plus commercial losses.

2/ $1.50 per man-day of general recreation.

3/ $1.50 per man-day of fishing, $6.00 per man-day for waterfowl hunting, plus commercial benefits.

Conclusion. As can be seen from the foregoing analysis monetary wildlife and fishery losses, even when assigned a high value, usually have little influence on the total annual charges developed for a large multiple purpose water resource project. This has resulted in the current policy of using a habitat or other ecologically based method in addition to monetary analysis for determining the significance of wildlife and fishery losses attributable to a Federal project. For the purpose of offically calculating benefits claimed for the Cooper Lake and Channels project, and the comparison of alternatives, the appropriate values should be those in Supplement 1 to Senate Document 97. This is due to the authorization date and status of the project, and to the fact that recreation was added as a project purpose in 1967, nearly 7 years prior to the effective date of P&S. If P&S values are to be used, the Corps believes the appropriate values to be assigned should be within the range provided and the same for both crediting benefits and determination of wildlife and fishery monetary losses. If these values are used, the overall benefit/cost analysis will be as economically sound as using the values recommended by the Corps from Supplement 1 to Senate Document 97.

Applicability of the Water Resources Council Procedures. The Water Resources Council published new "Procedures for Evaluation of National Economic Development (NED) Benefits and Costs in Water Resource Planning" in the Federal Register December 14, 1979. This manual includes new procedures which are to be used for determining

recreation benefits and losses of Federal water resource projects. Applicability of the new procedures is, in part, as follows:

a. The procedures apply to all Level C (project) planning subject to the P&S, including (1) projects that may be approved by agency administrators, (2) projects requiring Congressional authorization, and (3) authorized projects or separable features of authorized projects not yet under construction for which agencies currently prepare postauthorization planning documents. For the purposes of this manual, a project shall be considered "under construction" when funds have been appropriated by the Congress or budgeted by the President for land acquisition or physical construction activity. Projects for which postauthorization planning documents are not required shall be considered under construction when authorized for construction.

b. The Secretaries of Departments shall retain the discretion to review those projects not under construction and may, under their discretionary authority, wholly exempt a project from complying with this Manual of Procedures or partially exempt a project and direct expedited additional planning to meet specific procedures. This discretionary authority applies to those projects not yet authorized for which preauthorization planning is now complete or will be complete by the end of FY 1980 and to those authorized projects requiring postauthorization planning if such planning is now complete or will be complete by end of FY 1980. For purposes of applying this manual, preauthorization or postauthorization planning shall be considered complete when the appropriate planning documents have been approved by the responsible agency's field office. Secretarial authority to exempt projects from the procedures of this manual is provided to prevent undue loss of time or expenditure of public funds in those cases in which the Secretary judges additional planning to be unnecessary. This discretionary authority may not be exercised after July 31, 1981.

c. Authorized projects exempted from complying with the Principles and Standards are also exempted from complying with the procedures of this manual.

As stated previously, the Cooper Lake and Channels project was authorized in 1955 and is not subject to P&S except under discretionary authority by the agency. Various physical features of the project have been under construction since 1959, and land acquisition for the reservoir is 98 percent complete. Therefore, Cooper Lake and Channels is exempted from the manual under paragraphs a and c. Agency discretionary authority to exempt the Cooper Lake and Channels project under paragraph b could also be applied if the project were not considered under construction.

Changes in benefits with the new Water Resources Council Procedures. The new procedures provide three methods of determining net benefits for recreation at water resource projects: (1) Travel Cost, (2) Contingent Valuation, and (3) Unit Day Values. The Unit Day Value method has been applied to the Cooper Lake and Channels project planning studies using the values from Supplement 1 to Senate Document 97. These are the correct values to be used in project formulation, evaluation, and justification of benefits claimed for the project. The range of values in P&S has also been applied to show sensitivity of using different values for recreation and fish and wildlife net gains and losses in the previous analysis. Appendix 3 to Subpart K of the new manual provides a new schedule of applicable values if the Unit Day Value method is used. Using a value higher than the maximum values in this schedule is not allowed. Maximum value for general recreation is $3.22, for general hunting and fishing $3.20, for specialized hunting and fishing and other specialized recreation $12.87. The lowest value in the range listed is $1.07 for general recreation with low quality or low demand. Use of these new values, even though not applicable to the Cooper Lake and Channels project, would not significantly change project formulation and selection.

Benefit/Cost Analysis for Alternatives not Addressed in the Final EIS

Water supply only alternative. A "Water supply only" alternative was not addressed in the final EIS. This alternative was developed for presentation in the supplemental EIS. The formulation methodology and a detailed analysis of the benefits and costs are shown in appendix D, Plan Formulation. Benefit analysis for the Water Supply Only alternative is presented in section II of this appendix.

Benefits for final EIS nonstructural and combination measures. Benefits were not shown for flood control, water supply, recreation, fish and wildlife, and area redevelopment in various nonstructural measures or alternatives and combination nonstructural-structural alternatives presented in the final EIS. The most notable of the alternatives which does not show benefits in one or more categories are the nonstructural and combination plans along with flood insurance and flood warning and evacuation. The benefits for the above alternative plans were computed based upon several assumptions utilized in formulation of each plan. These assumptions are discussed in conjunction with each of the final EIS alternative plans in the following paragraphs. The nonstructural measures and alternatives have been reformulated into a comprehensive nonstructural plan for presentation in the supplemental EIS. Benefit analysis for the comprehensive nonstructural plan is presented in section II of this appendix, and the formulation methodology and benefit/cost evaluation is found in appendix D, Plan Formulation.

Fee purchase. The nonstructural fee purchase plan investigated in the final EIS proposed the buy-out of the entire 30-year flood plain both above and below the proposed damsite. The combination plan (reservoir and fee purchase) proposed the buy-out of the 30-year flood plain below the damsite only. Both past and present Corps economic policy requires that land and structures which are part of the project must be excluded from the benefit analysis. Since the payment for land and structures includes the amount of value which represents the damage portion, to count the damages as benefits would be double counting on both the costs and benefits side of the equation. Based on the above assumption, no damages were claimed nor flood control credited to the fee purchase plans. Benefits were generated under the assumption that implementation of these plans would place the land in public ownership which could be utilized for recreation and fish and wildlife purposes. Benefits attributable to these two project components were estimated at $370,100 and $122,100 for recreation and fish and wildlife, respectively, for the nonstructural plan. For the combination plan (reservoir and fee purchase) recreation and fish and wildlife benefits are $1,111,500 and $433,000, respectively. Detailed analysis of these benefits was included in section VI, page VI-36 of the final EIS. Annual charges for this nonstructural alternative were estimated at $1,782,500 with a resultant BCR of 0.3. Annual charges for this combination plan were estimated at $4,151,100 with a resultant BCR of 0.8.

Restrictive easement. Adoption of this nonstructural alternative would involve the purchase of a flowage easement for 89,200 acres located within the 30-year flood plan above and below the damsite. The combination alternative (reservoir and restrictive easement) involves 60,200 acres. The plans would prohibit the placing of any new structures in the flood plain but would not restrict agricultural usage of the lands under current guidelines. Based upon the definition of restrictive easement no change in current agricultural practices was assumed and the easement payment to the landowners would equate to all potential flood damage losses. Since the flowage easement payment would be based on the damages incurred, no benefits were claimed. Similarly, other possible benefits such as fish and wildlife also were not claimed as the flowage easement would not place the lands in public ownership. Annual charges for restrictive easement only were estimated at $1,149,000 with a resultant 0.0 BCR. For the combination of reservoir and restrictive easement annual charges were $3,696,100 with a BCR of 0.9

Nonrestrictive easement. This measure would entail making a one time payment for future flood losses within the affected 30-year flood plain. The damages were assumed to be a project cost. Landowners would be permitted to continue practicing farming and to place structures in the flood plain. The plan would not produce flood control benefits for any of the potential damage categories within the flood

plain. Again, the land would remain in private ownership and could not be controlled and would not generate recreation or fish and wildlife benefits. The annual charges to this nonstructural plan were estimated at $754,000 with a resulting BCR of 0.0. Annual charges for the combination plan (reservoir and nonrestrictive easement) were estimated at $3,458,100 with a BCR of 0.9 resulting.

Flood insurance. The purchase of flood insurance does not prevent potential flood losses to flood plain inhabitants. Rather, the damages and costs of insurance are redistributed between an individual and the nation as a whole. Federal Insurance Administration, the agency responsible for the operation of the program, insures all types of structures including farm buildings. State and local governments participating in the program enforce land use and control measures that guide land development in flood prone areas in order to avoid and reduce future flood damages. The major effect is on existing and future structures located within the 100-year flood plain. The final EIS noted that there were no habitable structures in the flood plain. Recent investigations for the comprehensive nonstructural plan revealed, however, that two habitable structures and seven small farm structures are located within the 100-year flood plain. Average annual flood damages for these structures are estimated to be about $200 for the habitable structures and $200 for the farm buildings. Other items within the flood plain, such as cattle and crops, are not insurable under the FIA program. In view that the annual flood damages to these structures are minimal and most of the damages consisted of non-insurable properties, the purchase of flood insurance was not considered a viable alternative and no benefits or costs were developed for the option.

Flood plain zoning. Flood plain zoning encompasses a number of regulations regarding flood plain activities such as adherence to building codes or restrictive use. While Texas counties have the authority under the Texas Flood Insurance Act to adopt and enforce flood plain zoning, the tool does not apply to damageable croplands in a flood plain. These regulations generally are applicable to existing structures and future structures located in the flood plain. Thus, zoning regulations established in connection with the Flood Insurance Act are generally more useful and effective in urban communities than in rural areas. Current regulations allow owners of existing structures to repair damages experienced from flooding but not to make improvements or additions to the damaged structures. Individuals desiring to build new structures in the flood plain are required to raise the floor elevation to at least 100-year flood level in order to minimize the threat of flooding.

In the case of the Sulphur River flood plain, it was determined that adoption of zoning regulations alone would not be a very effective measure to control flood losses. This was due to the fact most of

the lands were committed to agricultural activities not covered under the FIA program and the rural nature of the area. As indicated above, recent studies revealed that there are only two habitable structures located within the 100-year flood zone. The likelihood for any extensive new development also appears highly doubtful. Given these circumstances, further investigations did not appear warranted and this nonstructural measure was omitted as a possible option to control flooding in the affected study area.

Flood warning and evacuation. This nonstructural measure can be an effective tool in avoiding flood losses if ample warning can be provided flood plain occupants. Unfortunately, the Sulphur River rises rather rapidly, and experiences flash flooding peaks rather than slow rising peaks which can be easily predicted. Losses of cattle and farm equipment during the 1971 flood help support the river's potential to rise rapidly. Thus, it is felt that a flood warning system would not provide sufficient time for agricultural producers to remove their cattle and equipment. Given this situation, it was decided that flood warning and evacuation measures would not be practicable and no benefits or costs were developed for this type system.

APPENDIX C

SECTION II

BENEFIT EVALUATION FOR 1974 PRICE LEVEL

Introduction

This section of the report documents economic investigations and analysis made to determine the project benefits that would be assignable to the four management plans given detailed consideration in reformulation studies made during 1979 and 1980. The investigations undertaken and the procedures and evaluations conducted to calculate estimates of the project benefits are described in subsequent paragraphs. The benefits assigned to the plans evaluated encompass only those that are tangible and quantifiable. In calculating the benefits, the prices were set at 1974 levels and a 100-year period of analysis (1990-2089) with a project interest rate of 3-1/4 percent imposed.

Prior reports prepared by the Corps in the mid 1970's and supporting computations contained in working papers served as the principal data sources for these current studies. Two key documents referred to extensively were "Alternative Plans Studies, Appendix to Summary Report" prepared by Forrest and Cotton, Inc., Consulting Engineers, dated March 1975, and "General Design Memorandum No. 2-B, Revised Supplement No. 1, Plan Selection Report," prepared by New Orleans District, dated February 1977 and revised June 1977. As part of these current studies, a review was also made of the economic and land use data collected in the previous studies. Utilizing these data, reevaluations were conducted to develop estimates of the project benefits assignable to the various plans investigated.

Plans investigated. As noted earlier, formulation studies involved reevaluation of the 22 alternative previously developed and evaluations of selected new alternatives. As a result of these investigations, four alternative management plans were selected for detailed consideration. A brief description of the pertinent project features and planning objectives provided under each of the plans is presented in table 6.

Surveys. Prior investigations included field surveys of the area in 1972 to obtain pertinent data on prevailing economic conditions and land use activities. These surveys were made by Forrest and Cotton, Inc., an A-E consultant. As part of the contractor's activities, interviews were conducted with representatives of the Agricultural Stabilization and Conservation Service and committee members, Soil Conservation Service and numerous farmers and ranches in the area. Aerial photographs prepared from overflights made in early

TABLE 6

MANAGEMENT PLANS INVESTIGATED IN DETAIL

Planning Objective	Reservoir and Levees	Reservoir only (Recommended FWD Plan)	Reservoir Water Supply only	Comprehensive Nonstructural
Flood Damage Reduction	Reservoir contains 131,400 acre-feet of flood control storage capacity, 26.9 miles of additional levees and 6.6 miles of channel. Provides 30-yr flood protection to about 24,300 acres of agricultural lands below the dam.	Reservoir contains 131,400 acre-feet of flood control storage capacity. Provides 30-yr flood protection to about 12,900 acres of agricultural lands below the dam.	No provision for flood damage reduction measures.	About 66,200 acres within the 3-year flood plain proposed to be a natural habitat. About 19,100 acres between the 3- and 30-yr flood limits recommended for agricultural use. Encourages flood damage reduction through voluntary changes in farming practices and the adoption of various flood proofing measures.
Water Supply	Reservoir storage of 273,000 acre-feet to provide an ultimate yield of 169 cfs or 109.0 mgd.	Reservoir storage of 273,000 acre-feet to provide ultimate yield of 169 cfs or 109.0 mgd.	Reservoir storage of 273,000 acre-feet to provide ultimate yield of 169 cfs or 109.0 mgd.	
Recreation (includes fish & wildlife)	Reservoir to provide 19,305 acres of water surface and 58 miles of shore line, 3,300 acres for parks at 7 sites.	Reservoir to provide 19,305 acres of water surface and 58 miles of shore line, 3,300 acres for parks at 7 sites.	Minimal recreation facilities to be provided for health and safety purposes.	Recreation corridor of 24,200 acres with nine access points.

1972 and USGS topographic maps were utilized in defining existing land uses and delineating the flood plain limits. In 1974 the contractor resurveyed the study area. Minor adjustments were made where appropriate in the field data and land use maps to reflect 1974 conditions.

Study area. The study area was defined as that region that would be most significantly affected by the plans investigated. The area identified encompassed six counties: Red River, Lamar, Delta, Hopkins, Franklin, and Titus counties. The South Sulphur and Sulphur Rivers form the boundaries between Lamar, Delta, and Red River counties on the north side, and Hopkins, Franklin, and Titus counties on the south side. Numerous small cities are scattered throughout the region with the largest being Commerce, Sulphur Springs, Mount Vernon, Mount Pleasant, and Paris. The flood plain lands within the study area extend from Highway 259 at the eastern end of the basin about Wright Patman Lake to a western limit near the county line between Delta, Hopkins, and Hunt counties at Highway 271. There are no towns within the area surveyed.

Land Use

Land use studies made in connection with the 1974 evaluations gave consideration to both those areas above and below the proposed damsite. FWD studies covered the same area and are based on existing (status quo) conditions that prevailed shortly after the time of the court injunction. The 1972 aerial photographs served as base maps in the land use classifications. Existing land use activities were categorized according to three major types of use, i.e., woodlands, semi-wooded, and cleared lands.

The flood plains lands along the Sulphur River were found to have certain associated economic activities. The woodland areas were mainly used as marginal feeding grounds for cattle grazing and for commercial timber production. Green ash and oak are the two principal types of trees harvested from the woodland areas. Ranchers used the semi-wooded and cleared areas as pastures for cattle production. Only a small amount of acreage was found in row crops. Farming of these lands, however, was expected to be phased back into pastureland in the near future based on agricultural trends at the time. Coastal bermuda grasses would be grown in these converted areas which would be similar to the dominant type of grasses grown in existing flood plain pasturelands.

Without project (status quo) land use conditions. Future land use activities in the study area are expected to remain in a near static state under without project conditions. The potential does exist for some wooded areas to be converted to pasturelands in the future.

The amount of acreages involved, however, is expected to be insignificant and would not warrant adjustment in future without project land use conditions. A total of 91,200 acres of land are located within the study area of which 65 percent is wooded, 14 percent is semi-wooded and 21 percent is in cleared lands. A summary of existing land uses, by major activity, is presented in table 7.

With project land use conditions. The land area that would be protected under with project conditions would vary under each of the structural plans investigated. Out of a total of 97,000 acres, the Reservoir and Levees plan would provide flood protection to about 9 percent of the cleared areas, 3 percent of the semi-wooded areas, and 12 percent of the woodlands. In the case of the Reservoir Only plan, flood protection would be provided to about 8 percent of the cleared areas, about 2 percent of the semi-wooded areas, and 3 percent of the woodlands. The Water Supply Only plan does not include provision for any flood protection downstream of the damsite. Similarly, there are no provisions for flood protection in the comprehensive nonstructural plan investigated. Instead, it is proposed that present land use activities that currently sustain flood losses be altered to uses more compatible with the recurring flooding situation. Overall, the nonstructural plan would encompass about 85,300 acres of land of which agricultural usage would be recommended on only about 22 percent of the area. The land area within the 3-year flood zone would encompass 66,200 acres of which 5 percent consists of cleared lands, 10 percent is semi-wooded and 85 percent is in woodlands. This zone is recommended as a natural habitat area. The land area between the 3-year and 30-year flood frequency would be dedicated to agricultural usage. A total of about 19,100 acres lie within this zone of which about 67 percent is cleared lands, 16 percent is semi-wooded, and 17 percent is woodlands. A more detailed description of anticipated land use changes that would occur if the Comprehensive Nonstructural plan were implemented is presented subsequently in this section. Acreage estimates of the anticipated major land use activities for this plan were previously presented in table 7.

Structural and Nonstructural Plans Benefit Evaluations

The procedures used to estimate the benefits expected to accrue to the three structural plans and the one nonstructural plan investigated are described in the following paragraphs. Project related purposes examined to determine the benefits accruing to the particular element included in each plan:

- Estimating the inundation reduction benefits to agricultural and non-agricultural properties that occur with the flood control improvements.

TABLE 7

ANTICIPATED LAND USE ACTIVITIES UNDER WITH AND WITHOUT PROJECT CONDITIONS

Type of Land Use	No Action (Status Quo)	Alternative Plan Investigated: Reservoir and Levees	Reservoir Only	Reservoir Water Supply Only	Comprehensive Nonstructural
		(in acres)			
Unprotected	30-yr	30-yr	30-yr	30-yr	0-3-yr
Wooded	58,000	38,500	48,000	51,200	56,300
Semi-wooded	12,300	4,600	6,500	8,000	6,600
Cleared	18,900	5,200	8,500	16,700	3,300
Acres in projects	2,000	21,600	21,000	21,300	0
(non-usable)	(2,000)	(2,000)	(2,000)	(2,000)	
(water supply lake)		(19,300)	(19,300)	(19,300)	
(levees & channels)					
Subtotal	91,200	69,900	84,000	97,200	66,200
Protected		30-yr	30-yr		3-30-yr
Wooded	0	11,900	3,200	0	3,200
Semi-wooded	0	3,300	1,500	0	3,000
Cleared	0	9,100	8,200	0	12,900
Prior works	0	3,300	0	0	0
Subtotal	0	27,600	12,900	0	19,100
Total acres	91,200	97,500	96,900	97,200	85,300

- Calculation of agricultural intensification benefits that would be realized by agricultural producers with the flood control improvements, additional protection would be afforded to the flood plain occupants. This, in turn, would allow for more intensified and efficient use of these lands resulting from the reduced flood hazard.

- Evaluating water supply benefits expected to result from the construction of Cooper Lake reservoir.

- Measuring the recreation opportunities afforded by the various management plans.

- *Identification and* estimation of the area redevelopment benefits that would result by the hiring of underemployed and unemployed manpower in the construction and operation of the project.

- Determination of the fish and wildlife benefits that would accrue to the plans considered as a result of increased fishing and hunting opportunities.

- Calculation of the storage exchange benefits that would be derived as a result of converting flood control storage space Wright Patman Lake to municipal and industrial water supply space. The inclusion of the flood control storage at Cooper Lake site would be provided to allow the above transfer to take place.

As noted earlier, recent studies made by FWD included a thorough review of prior economic evaluations and reports. These investigations revealed that the procedures utilized generated reasonable estimates of the benefits for many of the project outputs. As a result of these findings most of the methodologies and benefit estimates described herein were obtained from the GDM, Supplement No. 1, Plan Selection Report, dated February 1977, revised June 1977, and from working papers. Two exceptions are the water supply and fish and wildlife benefits claimed. These two benefit categories were reanalyzed because of changes in the project costs which, in turn, altered the water supply benefits claimed, and an updated estimate of the fish and wildlife benefits was developed by the U.S. Fish and Wildlife Service. A detailed description of the techniques utilized in evaluating the three structural plans are presented herein. Economic evaluations made in connection with the Comprehensive Nonstructural plan considered also are documented in this section of the report.

Agricultural benefits. Two basic types of cattle operations are involved in the project area. These are cow-calf enterprises, generally involving one cow for every four acres of land and resulting in a weaned calf crop of about 78 percent under average management conditions; and stocker-calf enterprises, in which calves are purchased and generally grazed at the rate of 1.25 animals per acre with

an average death loss of 4 percent under average management conditions. Under advanced management conditions, cow-calf enterprises will support one cow for every two acres and result in a weaned calf crop of 90 percent, and stocker-calf enterprises will support 2.0 animals per acre with a death loss of about 2 percent.

The economic yield of an acre of grazing land depends on the type of operation, i.e., cow-calf or stocker-calf enterprise; and, the type of management the yield based on an average calf weight of 400 pounds, a weaned calf crop of 78 percent with one cow for every four acres, amounts to 78 pounds of veal per acre. Based on current normalized prices for the State of Texas of $46.20 per hundred weight for veal, this amounts to $36.04 per acre. In addition cull cows and bulls represent an economic yield equal to approximately 20 percent of the calf production or another $7.21 per acre. This results in a total economic yield of $43.25 per acre for the cow-calf enterprise under average management conditions.

Under average management conditions, a typical stocker-calf enterprise involves purchase of calves at 400 pounds which are subsequently sold at 650 pounds. Based on the 4 percent death loss and 1.25 animals per acre, the total gain in weight per acre amounts to 280 pounds with the resulting economic yield of $129.36 per acre.

Under advanced management conditions, a cow-calf enterprise with one cow for every two acres and a weaned calf crop of 90 percent with an average calf weight of 500 pounds, yields 225 pounds per acre, or $103.95 per acre returned on calf production. In addition, cull cows and bulls produce a yield of about 14 percent of the calf production or an additional $14.55 per acre resulting in the total economic return of $118.50 per acre. In the case of stocker-calf enterprise under advanced management in which calves are stocked at 400 pounds and sold at 700 pounds and experience only a 2 percent death loss, the average yield is 572 pounds per acre resulting in an economic return of $264.26 per acre.

Typical land utilization with the Sulphur Valley bottom involves approximately 20 percent under advanced management and 80 percent under average management with 30 percent of each category in stocker-calf enterprises and 70 percent in cow-calf enterprises. Accordingly, the weighted average economic return per acre has been computed as follows:

Cow-calf advanced	=	0.70	x	0.20	x	$118.50	=	$16.59
Cow-calf average	=	0.70	x	0.80	x	$ 43.25	=	$24.22
Stocker-calf advanced	=	0.30	x	0.20	x	$264.26	=	$15.86
Stocker-calf average	=	0.30	x	0.80	x	$129.36	=	$31.05
Weighted Average Economic Return Per Acre							=	$87.72

The weighted average return of $87.72 per acre represents the economic potential of the Sulphur River bottomland. In evaluating the economic benefit associated with the proposed alternatives, the basic procedure has been to ascertain the extent of damages that have occurred under the historical flood series to the area protected by each alternative. This involved the development of selected stage-area curves which compared the land area that would be flooded given different flood events. These curves were compiled using backwater profiles for each of the major land use categories considered in the study, i.e., wooded, semi-wooded, and cleared areas, under with and without project conditions. Exhibits 1 through 3 illustrate the resultant curves for the "status quo" conditions and structural alternatives investigated. These curves were then utilized in conjunction with the historic flood series from 1945 through 1971, inclusive, to determine the total area of cleared land and semi-wooded land protected by new works for each of the floods in this series. Damages prevented by each alternative were evaluated by utilizing a pasture damage curve prepared in 1958 Corps studies. The damage curve which relates percent damage due to inaccessibility (duration) and to stand (depth of flooding), by season determines the percent of average gross returns per acre. An example of this curve is shown in Exhibit 4. Since all of the values of damages are expressed in percent, the curves were considered valid and independent of current price or changes which have occurred since 1958. The historical peak floods, duration, semi-wooded, and cleared acres flooded and resultant damages and benefits under without and with project conditions are presented in Exhibits 5 through 7, respectively.

As noted above, estimates of the production losses per acre were computed by multiplying the total loss times the $87.72 average potential income per acre. An example of the computations used to develop agricultural benefits for the status quo and reservoir only conditions is shown in table 8. The basic concept behind this approach was that potential income increases gained from the cattle operations are directly dependent on utilization of the pasturelands. Thus, any loss in grazing time or damages to the pasture stand would result in a reduction in the weight gains of the cattle. One possible option to avoid this weight loss is to import grains and hay to feed the cattle evacuated to higher grounds during flood periods.

In view the economic return from the pas turelands are realized through marketing of beef, a fair measure of its value would be reflected in the potential weight gain of the cattle. Conversely, the damages sustained to the pasturelands from flooding would be the losses in weight the cattle would experience if they were not sustained by supplementary feeding. An example of the techniques incorporated to compute estimates of the agricultural damages for each of the floods listed in the 27-year historic series is presented in Exhibit 7.

TABLE 8

EXAMPLE OF AGRICULTURAL BENEFIT COMPUTATIONS

	Duration 1/	Cleared	Semi-Wooded	Total Usable	Percent Grazing 2/	Percent Stand 3/	Production Loss/acre 4/	Total Damage 5/
Peak Flood								
STATUS QUO								
1946 2 Jun	15 May-4 June	13,500	8,200	21,700	17	16	$28.95	$628,215
RESERVOIR ONLY								
1946 2 Jun	15 May-4 June	5,950	900	6,850	17	16	$28.95	$198,308

1/ Flood duration is 20 days (15 May through 4 June)
2/ 20-day flood duration + 10-day inaccessibility for total duration of 30 days. (See figure 2 and add damage percentages shown for 30-day period beginning 15 May (6+6+5 = 17%))
3/ See figure 2, read percent damage to pasture stand for 20-day duration on 2 June (16%)
4/ Production losses derived by multiplying percent losses times average potential income (16) x $87.72 + (17) x $7.72 = $28.95
5/ Total agricultural damages and benefits derived by multiplying total usage acres times estimated production losses (6850 x $28.95 = $198,308)

A summary display of the agricultural damages and benefits assignable to the status quo condition and for the structural plans considered is presented in Exhibits 5 through 7. These estimates were developed in a similar manner. In evaluating the agricultural benefits, assignable to the Reservoir and Levees plan, it has been necessary to recognize some additional factors beyond those reflected in the benefit computations associated with the historic flood series. These factors include an adjustment with reference to Levee 3RS which was not included in the flood series analyses, and benefits associated with wooded acreage protected by new works which will logically be converted to pastureland after completion of the new works. The adjustment with reference to Levee 3RS is based on the fact that this levee, and existing levee between State Highway 37 and U.S. Highway 271, provides flood protection which was originally attributed to prior construction and therefore was not included in the calculation of damages prevented by new works. However, based on further review, it was determined that the existing breached levee, if repaired, affords limited protection and would be insufficient to provide protection from even the 15-year flood. The major benefits associated with Levee 3RS are derived from the enlargement and repair, the cost of which has been included in the project cost estimates, as applicable, for the alternative plans and considered herein. Therefore, benefits associated with Levee 3RS, which amount to about $31,000 annually, have been added to this alternative plan even though the stage area curves presented in Exhibit 3 do not include the 3RS levee acreage. Resultant average annual agricultural benefits claimed for the three structural plans investigated are as follows:

Alternative Plan	Annual Agricultural Benefits Claimed
Reservoir Only (Supplemental EIS recommended plan)	$294,000
Reservoir and Levees	375,000
Reservoir Water Supply Only 1/	0

1/ Plan does not include provisions for flood control features

Non-agricultural benefits. In the floods from October to December 1971, and typically in other prior floods, heavy damages were sustained to fences and to existing levees which were either overtopped or ruptured at points of weakness, and other minor non-agricultural damage has been sustained by farm equipment left in low lying areas and from shoaling in drainage ditches and stock ponds. The largest single loss was to fences which were torn down by floating debris carried downstream by flood waters. Damage to the levees through crevassing is difficult to measure because the damages are not only a function of magnitude of flood but related to level of maintenance and to

non-predictable factors such as weakening due to burrowing of small animals within the levees.

In order to arrive at a fair basis for evaluating non-agricultural damages, consideration was given to data collected in damage surveys made on the floods of October through December 1971. Detailed damage estimates were compiled for the South Sulphur River and the main stem of the Sulphur River below the confluence of the North and South Sulphur Rivers. The reported flood losses along these two river reaches, which encompass the affected Cooper Lake Project area, were updated to July 1974 price levels. A summary of the non-agricultural losses, by type of property, is presented below:

Item	South Sulphur River	Percent of Total	Sulphur River	Percent of Total
Fences	$496,000	(59)	$527,500	(45)
Roads and bridges	21,800	(3)	22,900	(2)
Levees	306,000	(36)	618,800	(53)
Other (building equipment,etc)	12,400	(2)	0	(0)
Total	$836,200	(100)	$1,169,200	(100)

As shown, non-agricultural damages for the area inundated by the October-December 1971 floods totaled $2,005,400 of which, $836,200 occurred along South Sulphur River and $1,169,200 along the Sulphur River below Cooper Dam. Over 111,900 acres were inundated as a result of this flood. Flood losses were greatest to cleared and semi-wooded lands by virtue of the extensive fencing in these areas. Heavy damages also occurred in wooded areas particularly to the levees and at road crossings. For the purpose of this analysis, it was assumed that a fair measure of non-agricultural damages would be the average damage per acre considering all land subject to inundation whether cleared, semi-wooded, or wooded as determined by the damage survey for the October-December 1971 floods. This resulted in a non-agricultural damage figure of $17.92 per acre. Non-agricultural benefits were then computed by applying this figure to the average area of land inundated by the historic series (9,821 acres, Reservoir Only plan, and 16,797 acres, Reservoir and Levees plan). Estimates of the non-agricultural benefits assignable to the structural plans investigated are presented below:

Alternative Plan	Annual Non-agricultural Benefits Claimed
Reservoir Only (Supplemental EIS recommended plan)	$176,000
Reservoir and Levee	301,000
Reservoir Water Supply Only 1/	0

1/ Plan does not include provisions for flood control features

Agricultural intensification benefits. Construction of the flood control features provided for in the Reservoir Only and Reservoir and Levees plans is expected to result in increased utilization of agricultural lands located below the damsite. This higher use is expected to result from conversion of woodland areas to pastureland; cleared pastureland to cropland, and through increased crop yields. Information on changes in land use, crop yields, costs of production, and woodland conversion were obtained through interviews with County agents, Soil Conservation Service representatives, and landowners. A review also was made of published reports and agricultural statistical data compiled by the U.S. Department of Agriculture, Texas Crop and Livestock and Reporting Service to obtain pertinent farm cost and income data.

The amount of woodlands converted to pasture was based on the anticipated demand for increased agricultural production, soil types and capabilities within the present floodways, topography, size of woodland plots, and the relative elevation of the land surface. Under with project conditions, it was estimated that about 15 percent of the total area to be protected would be converted to cropland for raising hay. This involves conversion of all usable woodland to cleared or semi-cleared pasturelands. Without the improvements little or no land conversions are expected to take place. Only part of the total available area would be usable. Some lands would be required for sump storage of interior drainage behind closed levee systems and other areas would be unusable due to periodic backwater overflow around the ends of open levees. Based on these investigations, it was determined that about 20 percent of the protected area would not be suitable for conversion and would remain in a natural state. Accordingly, it was assumed that 80 percent of the existing woodland areas would be converted to cleared and semi-cleared land in the same proportion as they presently occur within the protected areas.

Net income changes due to the flood control improvements were determined using the farm cost and income data collected in the field investigations. The methodology applied to calculate estimates of the net productive value per acre for flood plain lands under without and with project conditions (recommended Reservoir Only and Reservoir and Levees plan) is presented in Exhibits 8 and 9. The net productive value of the agricultural activities in the flood plain was derived by subtracting the cost of production from the selling price, or the gross value of the activity. Ranching and/or farming practices were determined with and without project conditions using the agriculture census data and information obtained through the interviews with local ranchers, farmers, and knowledgeable agricultural representatives. As noted above, under improved conditions the threat of flooding would be reduced, which in turn will permit the more intensive use of the flood plain acreages. Agricultural interests would then be able to shift their ranching and farming practices to higher valued activities.

As shown in the table, net productivity of the affected flood plain lands are estimated to increase by about $209,000 and $688,000, annually under the Reservoir Only and Reservoir and Levees plans, respectively.

Agricultural net incomes, derived using the above procedure, were then further compared to determine the intensification benefits that would accrue to the plans investigated. To make this determination, consideration was given to the following factors: (a) the net return with and without the improvements; (b) differences of average annual flood damages with and without the improvements; (c) conversion costs incurred in modifying to the more intensive agricultural activities; and (d) allowance for the 10-year time lag for agricultural producers to convert to the new activities. Table 9 outlines the calculations made to derive estimates of the agricultural intensification benefits for the recommended Reservoir Only and Reservoir and Levees plans. Resultant estimates of the agricultural intensification benefits claimed for the structural plans investigated are as follows:

Alternative Plan	Annual Agricultural Intensification Benefits Claimed
Reservoir Only (Supplemental EIS recommended plan)	$158,000
Reservoir and Levees	516,000
Reservoir Water Supply Only 1/	0

1/ Plan does not include provisions for flood control features

Water supply benefits. Average annual water supply benefits assigned to Cooper Lake in the final EIS were $1,728,000. These benefits were originally calculated at the July 1968 price level, 3-1/4 percent Federal interest rate (as appropriate under Section 80 of the 1974 Water Resources Development Act), and a comparable non-Federal interest rate and bonding period of 4 percent and 25 years, respectively. The July 1968 water supply benefits were escalated through a series of price indexing to the July 1974 level of $1,728,000.

Water supply benefits are based on the average annual cost of an alternative source that would most likely be developed by non-Federal interests in the absence of a Federal multiple purpose project. The non-Federal source must provide water of comparable quantity, quality, and location with the multiple purpose project. Normal non-Federal practices for development and financing will be considered in estimating costs of this alternative.

In response to a final EIS deficiency noted in the Memorandum Opinion, a number of potential water supply alternatives were considered in Section III of Appendix D. The most likely alternative was shown to be a single purpose water supply lake at the multiple purpose Cooper

TABLE 9

AGRICULTURAL INTENSIFICATION BENEFITS
FOR STRUCTURAL PLANS INVESTIGATED

Item	Reservoir Only Plan	Reservoir and Levees Plan
Gross Return With Project	$986,000	$1,607,000
Less Average Annual Agricultural Damages With Project	-14,000	-15,000
Net Return With Project	$972,000	$1,592,000
Gross Return Without Project (Flood Free)	$777,000	$ 919,000
Less Average Annual Agricultural Damages Without Project	-308,000	-359,000
Net Return Without Project (With Flooding)	$469,000	$ 560,000
Increase in Net Return With Project	$503,000	$1,032,000
Less Average Annual Flood Damage Prevented	-294,000	-344,000
Total Return	$209,000	$ 688,000
Allowance for Lag in Land Conversion (10 years)	x.821	x.821
Discounted Net Return	$171,589	$ 564,848
Less Annual Cost for Land Conversion	-13,150	-48,900
Benefits Claimed for Intensified Agricultural Use	$158,439	$ 515,948
(Rounded)	$158,000	$ 516,000

Lake site. It is appropriate that the cost of this project be the basis for estimating average annual water supply benefits for the multiple purpose Cooper Lake. The estimated costs required to compensate for fish and wildlife losses of this water supply lake were included in benefit computation since non-Federal interests have recently included fish and wildlife mitigation plans in their projects as a condition for obtaining required Federal permits. Computation of water supply benefits at the July 1974 price level, 3-1/4 percent Federal interest rate, and non-Federal financing of 4 percent for 25 years is shown below.

FIRST COST	
Single purpose water supply lake (109 mgd)	$53,301,000
Compensation of fish & wildlife losses	8,338,000
Total First Cost	$61,639,000
INVESTMENT	
Total first cost	$61,639,000
Interest during construction (4 yrs at 4%)	4,007,000
Total Investment	$65,646,000
AVERAGE ANNUAL BENEFITS	
Equivalent annual payments for 25 yrs at 4%	
$65,646,000 x 0.064012 =	$ 4,202,100
Equivalent investment at 3¼% Federal rate	
$4,202,100 x 16.937863 =	71,174,600
Equivalent annual cost for 100 yrs at 3¼%	
$71,174,600 x 0.033884 =	2,411,700
Annual operation, maintenance, and replacement for lake =	183,200
Annual operation and maintenance for fish and wildlife compensation =	76,600
Total Average Annual Water Supply Benefits =	$ 2,671,500

Recreation/Fish and Wildlife Benefits

The development of recreational facilities associated with the plans investigated considered projected initial and optimum recreational uses over the life of the project (1990-2089). Benefits for each plan were calculated by assigning values to various activities in accordance with guidance contained in Supplement 1 to Senate Document No. 97. Methodology for determining those values is found in Section I of this appendix. These values are:

General Recreation (with highly developed facilities)	$1.50 man/day
General Recreation (minimum health and safety facilities)	$0.75 man/day
Sport Fishing (lake and stream)	$1.50 man/day
Big Game Hunting, Waterfowl	$6.00 man/day
Small Game, Upland Game	$2.00 man/day

These benefit values are correct for the purposes of evaluating benefits for the Cooper Lake and Channels Project and alternatives. For the purpose of showing sensitivity of plan evaluation and selection to values published in P&S, the following values are also assumed and displayed in the comparisons of alternative plans in the text of the supplemental EIS:

General Recreation	$0.75
Wildlife Oriented Recreation (non-consumptive)	$9.00
Sport Fishing (lake)	$0.75
Sport Fishing (stream)	$9.00
Hunting (big game, waterfowl, small game, upland game)	$9.00

It is noted that these values are assumed and are not the correct values to be officially used for claiming benefits. They represent a comparative analysis giving full monetary weight to fish and wildlife resources and uses, and low weight to general lake-oriented recreation. Benefits using these values are not displayed in this appendix.

Methodology for computing recreation benefits. The U.S. Fish and Wildlife Service (USFWS) has updated and provided new supply and demand information, and net man/day, sport hunting and fishing estimates, commercial, and other benefit/loss categories of fish and wildlife monetary elements in their current planning aid studies for the supplemental EIS. These fish and wildlife man/day use estimates are used for evaluating plans in the supplemental EIS, and are included in the following tables of benefits, in place of the values and methodology used in the final EIS filed 24 June 1977. Values for commercial fish potential and pelt values are based on USFWS estimates and 1974 price levels.

a. Reservoir multipurpose. The market area used in estimating recreation use for alternatives evaluated included those counties whose population centers lie within 100 road miles of the nearest point of access to any element of the system. The recreation uses assignable to these improvements were adjusted to allow for the influence of other competing projects. The main factors considered in determining recreational usage were the estimated population for the market area and the per capita use rates developed for the project. For the purposes of determining general recreation benefits assignable to the four alternatives evaluated in the supplemental EIS, the 741,000 average annual General recreation estimate used in the final EIS is retained for alternatives containing a multipurpose - Federal reservoir feature at the Cooper site. It is recognized that this represents a very conservative approach to estimating actual reservoir use since calculations conducted in accordance with applicable Corps regulations, and considering competition from other lakes, result in an average annual recreation use of some 1,508,000 visitors (1974 analysis). Details on methodology employed in these calculations is found in Section I of this appendix. The 741,000 visitation estimate is retained to represent a low range estimate of benefits for evaluation of plans involving a Federal multipurpose reservoir in the supplemental EIS. General recreation visitation estimates for the Water Supply Only plan and Nonstructural plan are based on 1974 conditions and projections to be compatible with the two multipurpose plans.

b. Water supply only. The market area for this feature is the same as in paragraph a., above. The main factors considered in determining recreation usage were the number of access points and the facilities which would be provided. The recreation use and benefits are relatively low since actually no recreation facilities would be provided. Only access and facilities for public health and safety, consisting of guardrails, turnarounds, and frame toilets at five locations, and guardrails and turnarounds at five other locations would be provided on existing road ends. Details on this plan are presented in Section III of Appendix D.

c. Nonstructural. The market area for this feature is the same as in paragraph a., above. The number of recreation days that reasonably could be expected for each recreation activity was determined by using facility standards based on the number of facilities which would be provided. Details on this plan are presented in Section IV of Appendix D.

Recreation use estimates are summarized below for the four plans in the final array.

ESTIMATES OF ANNUAL GENERAL RECREATION USE
(Expressed in Recreation Days)

Reservoir and Levees	741,000
Reservoir Only	741,000
Water Supply Only	182,000
Comprehensive Nonstructural	530,000

Fish and wildlife net gains and losses are displayed in table 10.

Summary of recreation benefits. The initial and optimum recreation benefits expected to result from the development of public use facilities are based upon projected recreational use and day use unit values for various activities. The initial and optimum recreation benefits were converted to average annual values based on an interest rate of 3-1/4 percent with a 100-year project life (1990-2089). The total average annual recreation benefits consists of the initial benefit plus the discounted future benefits. A summary of the average annual equivalent values is presented in table 11.

Area Redevelopment Benefits

The employment benefits claimed would be generated in areas qualified under the Public Works and Economic Development Act of 1965, as amended, Economic Development Administration, U.S. Department of Commerce. Qualified areas are defined as those counties which are officially designated as a title IV redevelopment area under the 1965 Act. The benefits would result from providing gainful employment to unemployed and underemployed local labor within a commuting distance of the project in the construction and subsequent operation of the proposed improvements. A brief description of the procedures followed in developing estimates of the area redevelopment benefits assignable to the structural plans investigated is presented below.

Redevelopment area. The project lies in or within commuting distance to 14 Texas counties. Nine are qualified as Title IV redevelopment areas under the Public Works and Economic Development Act of 1965, as amended. The counties and the basis for their qualifications are listed below.

TABLE 10

FISHERY AND WILDLIFE BENEFITS 1/
(No Mitigation)

	Reservoir & Levees		Reservoir Only		Water Supply Only		Comprehensive Nonstructural	
	Net Man/Days: Loss or Gain	$ Value	Net Man/Days: Loss or Gain	$ Value	Net Man/Days: Loss or Gain	$ Value	Net Man/Days: Loss or Gain	$ Value
Sport Hunting								
Whitetail Deer	-2,010	-12,060	-1,265	-7,590	-886	-5,316	+1,442	+8,652
Raccoon	-846	-1,692	-502	-1,004	-337	-674	+1,551	+3,102
Rabbit	-1,846	-3,692	-1,296	-2,592	-1,040	-2,080	+760	+1,520
Quail	-108	-216	-166	-332	-181	-362	-190	-380
Squirrel	-8,987	-17,974	-5,415	-10,830	-3,525	-7,050	+7,948	+15,896
Dove	0	0	0	0	0	0	-85	-170
Turkey	0	0	0	0	0	0	0	
Coyote	-199	-398	-237	-474	-270	-540	+303	+606
Fox	+14	+28	+40	+80	+43	+86	+27	+54
Net Total	-13,982	-36,004	-8,841	-22,742	-6,196	-15,936	+11,756	+29,280
Sport Fishing								
Stream	-2,254	-3,381	-2,254	-3,381	-2,254	-3,381	0	0
Lake	+192,202	+288,303	+192,202	+288,303	+96,100	+144,150	0	0
Net Total		+284,922		+284,922		+140,769		0
Commercial Fishery	Lbs	$ Value 2/	Lbs	$ Value	Lbs	$ Value	Lbs	$ Value
Lake Fishery	+64,720	+9,708	+64,720	+9,708	+64,720	+9,708	0	0
Stream Fishery	-5,632	-844	-5,632	-844	-5,632	-844	0	0
Net Total		+8,864		+8,864		+8,864		0
Commercial Trapping 3/		-2,626		-1,705		-1,285		+2,358

1/ SOURCE: USF&WS 1980 Supply/Demand Study for Cooper Lake; in average annual equivalents at 3-1/4 percent interest.

2/ $0.15/lb average value; source: USF&WS reservoir analysis of fishery potential.

3/ Loss or gain in potential pelts for eight furbearing species, and 1974 pelt values; source: USF&WS October 16, 1980, Planning Aid Letter.

TABLE 11

SUMMARY OF RECREATION AND FISH AND WILDLIFE BENEFITS
AVERAGE ANNUAL EQUIVALENT VALUES
(Without Mitigation)

Benefit Category	Reservoir & Levees	Reservoir Only	Water Supply Only	Non-structural
	(in $1,000's)			
Fish and Wildlife				
Sport fishing	$ 284.9	$ 284.9	$ 140.8	$ 0.0
Sport hunting	-36.0	-22.7	-15.9	29.3
Commercial fishery	8.9	8.9	8.9	0.0
Trapping	-2.6	-1.7	-1.3	2.4
Subtotal	$ 255.2	$ 269.4	$ 132.5	$ 31.7
General Recreation	1,111.5	1,111.5	136.5	795.0
Total	$1,366.7	$1,380.9	$ 269.0	$ 826.7

County	Criteria for Qualification
Bowie	8
Camp	8
Cass	8
Delta	2
Fannin	8
Franklin	-
Hopkins	-
Hunt	-
Lamar	8
Morris	8
Rains	2, 8
Red River	2, 8
Titus	-
Wood	-

Definitions: 2 is a low-median family income area
8 is a substantial unemployment area

Employment benefit calculations. Estimates of the area redevelopment benefits were derived giving consideration to that portion of the estimated construction costs for each alternative considered that would be allocated to labor. It is anticipated that sufficient unemployed and underemployed labor would be available within the project area to meet these construction labor demands as well as the project operation and maintenance labor needs. Labor expenditures were estimated to represent 27 percent of total construction expenditures; 57 percent of these labor charges will be expended on otherwise unemployed and underemployed labor. Furthermore, it was assumed that the supply of underemployed and unemployed labor available for O&M requirements would uniformly decline to zero over the next 20 years. O&M labor expenditures are estimated to represent 38 percent of total expenditures; 65 percent of O&M labor charges will be initially expended on otherwise unemployed and/or underemployed labor. The actual calculations performed to estimate the area redevelopment benefits assignable to the plans investigated are outlined in table 12.

The present worth value of the total wages accepted as employment benefits were computed for the initial year of the project life (1990), using the authorized project interest rate of 3-1/4 percent. Estimates of the average annual equivalent benefits for employment of workers in the construction and subsequent operation of the project were derived by applying the capital recovery factor for 3-1/4 percent. A summary of the average annual area redevelopment benefits claimed for the three structural plans investigated are as follows:

Alternative Plan	Annual Redevelopment Benefits Claimed
Reservoir Only (supplemental EIS recommended plan)	$249,500
Reservoir and Levees	293,200
Reservoir Water Supply Only	208,400

TABLE 12

CALCULATION OF AREA REDEVELOPMENT BENEFITS

Total Estimated Construction Costs	Portion Allocated to Labor (%)	Available Labor (%)	Total Employment Benefits Claimed	Average Annual Employment Benefits
		Reservoir Only Plan		
Construction Expenditures $41,397,000	27	57	$6,370,998	$215,849
O&M Expenditures $ 478,500	38	65	$ 118,180 1/	33,639
				$249,488
			Total	$249,500 (rounded)
		Reservoir and Levees Plan		
Construction Expenditures $49,354,000	27	57	$7,595,581	$257,338
O&M Expenditures $ 510,800	38	65	$ 126,168 1/	35,911
				$293,249
			Total	$293,200 (rounded)
		Reservoir Water Supply Only Plan		
Construction Expenditures $36,559,000	27	57	$5,759,560	$195,473
O&M Expenditures $ 183,200	38	65	$ 45,250 1/	12,879
				$208,352
			Total	$208,400 (rounded)

1/ Employment benefits for O&M expenditures uniformily decreased to zero over a 20-year period. Annual benefits derived by dividing present worth value by 20 and multiplying by present value of a decreasing annity for 20 years times the capital recovery factor at 3-1/4 percent

Storage Exchange Benefits

These benefits would be generated as a result of the conversion of 120,000 acre-feet of flood control storage at Wright Patman Lake to municipal and industrial water supply space. The inclusion of 131,400 acre-feet in flood control storage at the Cooper Lake site would allow the transfer of the flood control space from Wright Patman Lake. Flood control benefits attributed to Wright Patman would then be shifted to Cooper Lake as the latter reservoir would preserve the downstream flood protection.

The methodology adopted to allocate the benefits between the two reservoirs was determined by establishing a ratio (expressed as a percent) between the volume exchanged to the existing total volume in Wright Patman Lake. This percentage was then applied to the flood control benefits assignable to Wright Patman Reservoir to determine the proportionate flood control benefits from storage exchange.

The storage exchange benefits for Cooper Lake were computed as follows:

- The 120,000 acre-feet flood control storage exchange to Cooper Reservoir divided by the total 2,509,000 acre-feet of flood control storage in Wright Patman Reservoir resulted in a 4.78 percentage ratio.

- The 1969 flood control benefits for Wright Patman Reservoir were estimated at $401,000 and $715,000 for crop and intensification, respectively.

- These benefits were updated to 1974 price levels using WRC Agricultural Price Standards "all crop prices" index. A factor increase of 2.11 was applied.

- Updated 1974 flood control benefits assignable to Wright Patman Reservoir totaled $2,355,000, of which $846,000 were flood damage reduction benefits to crops and $1,509,000 were agricultural intensification benefits.

- The sum of these benefits were then multiplied by 4.78 percent to determine the benefits to be transferred between reservoirs. The resultant storage exchange benefits claimed for the structural plans investigated are as follows:

Alternative Plan	Annual Storage Exchange Benefits Claimed
Reservoir Only (supplemental EIS recommended plan)	$113,000
Reservoir and Levees	113,000
Reservoir Water Supply Only 1/	0

1/ Plan does not include provisions for flood control works.

Nonstructural Plan Benefit Evaluation

This section of the report presents details on the investigations and analyses performed in connection with evaluating the benefits assignable to the Comprehensive Nonstructural plan. This alternative, developed as a result of recent (1979-80) studies made by FWD, provides for a combination of nonstructural flood damage reduction and flood plain management measures to reduce flood losses in the Sulphur River flood plain. Specific project components making up the plan are outlined below in the plan description. Project benefits expected to be generated from this plan include:

- Agricultural flood damage reduction
- Agricultural intensification
- Non-agricultural flood damage reduction
- Recreation and Fish and Wildlife

Plan description. In brief, the Comprehensive Nonstructural plan basically provides for voluntary land use changes which would encourage uses for the flood plain compatible with the flood hazard. Implementation of the plan would rest with the individual landowners. Support to participate in the plan would be offered through Federal technical assistance and public awareness programs. Recreation features also would be provided to function in concert with the flood damage reduction aspects of the plan. Flood damage reductions would be accomplished primarily by decreasing expenditures for damages to non-agricultural properties and by changing to agricultural activities less subject to flood damages. Adoption of the plan also would reduce the flood damages to the two existing habitable structures located within the flood plain. Specific nonstructural measures recommended to achieve flood damage reductions are as follows:

- Dividing the flood plain into three zones (referred to herein as the habitat zone, pastureland zone, and cultivated zone) in order to promote land use activities compatible with the flood hazard. The habitat zone would encompass 66,200 acres along both sides of the river within the 3-year flood plain. The area in the habitat zone would be allowed to revert to a natural state. The cultivated zone would encompass all lands between the 3-year and 30-year flood plain. Cultivation of row crops would be permitted in this zone. The zone would comprise 19,100 acres of land. Grazing in the pastureland zone would be managed to minimize erosion and assure sound land treatment practices. This zone would consist of all flood plain land above the 30-year flood level.

- Floodproofing of existing habitable structures by raising their floor elevation to greater than the 100-year flood level.

- Restricting future development below the 100-year flood level.

- Continued maintenance of two existing levees (5RSS and 1RS) to provide flood protection to lands located behind these levees.

- Technical assistance for crop selection and location of zones.

A detailed description of the pertinent features to be provided in the Comprehensive Nonstructural plan is contained in Plan Formulation, Appendix D.

Agricultural activities. Corps personnel consulted soil survey reports prepared by the USDA Soil Conservation Service and interviewed individuals versed in agricultural practices in order to select crops which would be compatible with the flood hazard and profitable as well. These investigations revealed that no cultivated crops other than certain species of trees could successfully be grown inside the 3-year flood plain. The major problems encountered with growing crops in this low-lying area are the depths of flooding and the long duration of standing water which result in drowning the crops at the seedling stage and produce muddy conditions during harvest. Given these conditions, the Corps recommends only natural flood plain vegetation inside the 3-year frequency flood elevation. The most promising crops for production above the 3-year flood plain was found to be improved pasture planted in coastal hay and green ash and cottonwood tree production in the existing wooded areas. Cotton and soybeans were also found to be suitable crops for the area. However, the potential income from these crops would be less than from pasture. Other crops considered included sugar cane, rice, and small grains. However, it was found that these crops were either not as profitable or adaptable to this region as the aforementioned crops. Table 13 presents estimates of potential profits that could be generated by growing the crops listed. The profit estimates shown were developed from Texas Crop and Livestock Budgets, 1979-80, prepared by the Texas Agricultural Extension Service. These budget figures were adjusted to reflect 1974 WRC normalized prices and flood plain yields. For cattle operations, the expected profits under flood-free conditions were calculated for stocker-calves and cow-calf operations assuming typical and advanced management practices. The per acre figure given in table 13 for cattle operations is based on a weighted average of the profits for these four types of cattle operations. Similar to the rationale applied in the structural benefit analysis, the cattle operations were assumed to consist of 70 percent cow-calf and 30 percent stocker-calves, with advanced management techniques applied to 20 percent of all operations and typical management on the remaining 80 percent.

TABLE 13

ESTIMATED POTENTIAL INCOME GENERATED FROM VARIOUS AGRICULTURAL ACTIVITIES IN THE SULPHUR RIVER FLOOD PLAIN

Type of Agricultural Activity	Management Level	Estimated Profit Per Acre for 1974 1/
Cattle Operations	Typical	$38.38
Hay Production	High	45.23
Hay Production	Typical	22.61
Soybeans	High	32.39
Soybeans	Typical	17.45
Oats	High	-16.21
Oats	Typical	-25.84
Cotton (lint & seed)	High	- 5.18
Cotton (lint & seed)	Typical	-34.13
Grain Sorghum	High	-53.27
Grain Sorghum	Typical	-61.90
Wheat	High	1.31
Wheat	Typical	-10.91
Timber Production	Typical	12.69

1/ Estimated profit per acre figures for crops are based on 1974 WRC normalized price levls; for timber production, profit figures are based on information provided by the Texas Forest Service.

For timber production, income would ~t be realized annually but would occur at selected future years wh .he trees were harvested. In order to develop an annualized value per acre comparable to the income figures for crops and cattle, an analysis was made of costs and income for timber operations over the 100-year project life. Estimates of conversion costs and future costs and incomes, based on 1980 price levels, were developed using information provided by the Texas Forest Service. Potential future income sums were discounted at the project interest rate of 3-1/4 percent. The Producers Price Index for Lumber from the Survey of Current Business, U.S. Department of Commerce, was the economic indicator selected to adjust the 1980 prices to a January 1974 price base. This analysis resulted in an estimated annualized profit of $12.69 per acre for timber production.

With project land uses. On the basis of the above investigations agricultural activities compatible with the flood conditions along the Sulphur River, which would be economically more attractive in light of the fact that flood conditions will continue to occur, were identified. The following assumptions were made.

- The 56,300 wooded acres inside the 3-year flood plain known as the habitat zone will remain unchanged. An additional 9,900 acres of cleared and semi-wooded land will be allowed to gradually revert to natural habitat.

- The 3,200 acres in the cultivated zone that is currently wooded will be harvested and converted to managed forest production.

- Eighty percent, or 2,400 acres of the 3,000 acres of semi-wooded land to be cleared, will be converted to new crop production. The remaining 20 percent, or 600 acres, will remain in cattle production.

- Eighty percent or 10,300 acres of the 12,900 acres of cleared land in the cultivated zone will be converted to new crop production. The 2,600 acres of cleared land remaining will continue in cattle production.

The most advantageous new crop to plant in existing semi-wooded and cleared areas of the cultivated zone was found to be improved pasture planted in coastal hay to be used for sale. It is assumed that high management practices will be utilized on the 80 percent of cleared land that is converted to hay production and that typical management will result on the 80 percent of semi-wooded land that is converted to hay production. These assumptions reflect the existing variance in management techniques within the flood plain, and the differences in costs for converting cleared and semi-wooded lands. Conversion of cleared land to more intensive management is incrementally less costly than conversion of semi-wooded land to high management production. The remaining lands in both cleared and semi-wooded areas were assumed to remain in cattle production.

A summary of anticipated land use activities with and without the Comprehensive Nonstructural plan is shown in table 14.

Agricultural flood damage reduction benefits. Procedures similar to those used in the analysis of the structural alternatives investigated were incorporated into the nonstructural benefit evaluations. This basically involved use of historic flood series data which reflected the percent damage in terms of lost grazing and in terms of percent of stand. The production loss per acre was expressed in dollars and was arrived at by multiplying the total percent loss by the average potential profit ($37.72). Again, the basic philosophy involved was that the potential profit gained by virtue of the cattle operations was based on the utilization of the pasturelands. Thus, a loss in grazing time or damages would be reflected and proportionate to a reduction in the rate of weight increase of the cattle. In turn, these evaluations were restricted to determining the flood damage reduction benefits in only thos areas that would be affected by the nonstructural plan which involved 31,200 acres in the 30-year flood

TABLE 14

LAND USE ACTIVITIES WITH AND WITHOUT THE PROJECT

Area	Cleared	Semi-wooded	Wooded	Total
		(in acres)		
		Without the Nonstructural Project		
Habitat Zone	3,300	6,600	56,300	66,200
(cattle)	(3,300)	(6,600)	(0)	(9,900)
(habitat)	(0)	(0)	(56,300)	(56,300)
Cultivated Zone	12,900	3,000	3,200	19,100
(cattle)	(12,900)	(3,000)	(0)	(15,900)
(habitat)	(0)	(0)	(3,200)	(3,200)
Totals	16,200	9,600	59,500	85,300
		With the Nonstructural Project		
Habitat Zone	0	0	66,200	66,200
(habitat)	(0)	(0)	(66,200)	(66,200)
Cultivated Zone	15,300	600	3,200	19,100
(cattle)	(2,600)	(600)	(0)	(3,200)
(habitat)	(0)	(0)	(0)	(0)
(timber production)	(0)	(0)	(3,200)	(3,200)
(hay production)	(12,700)	(0)	(0)	(12,700)
Totals	15,300	600	69,400	85,300

plain. Based on these investigations, agricultural damages in the 30-year flood plain from all floods totaled about $26,067,568, yielding an annual loss of $965.468 for the 27 years investigated (Exhibit 5). With 31,200 acres in cattle operations, the average annual loss amounted to $30.94 per acre.

Historically, there were no damages to hay in the basin because all cleared and semi-wooded areas were principally devoted to cattle production. For the purposes of these evaluations a flood frequency approach was selected to measure the potential hay damages. This procedure offered a simpler approach to computing average annual damages by weighting the effect of all floods without having to estimate the losses for individual floods in a long series of events. The damages were first determined based on 1980 conditions and price levels giving consideration to the seasonal probability of flooding in the Sulphur River Basin and depth-damage curves for hay crops developed by the Soil Conservation Service of the U.S. Department of Agriculture.

The average annual losses per acre for two management levels of hay production were adjusted downward from 1980 WRC normalized prices to reflect 1974 normalized price levels. This was done to place these figures on a comparable basis with the project costs and benefits for the other plans considered. On the basis of this analysis flood losses to hay crops were estimated at $17.99 and 12.02 per acre for high management and typical management, respectively.

The potential flood losses for existing and proposed agricultural activities are displayed in table 15. As shown in the table, no flood damages were claimed for areas converted to timber production because little or no losses from flooding would occur to the woodlands. With the nonstructural project, average annual damages are estimated to decrease from $965,000 to $313,000, resulting in flood damage reduction benefits of $652,000.

Agricultural intensification benefits. Expected annual returns to the agricultural producers using the 30-year flood plain would decrease under the with project condition. This would occur principally because agricultural activities would be discontinued on 12,100 acres in the 3-year flood plain. As shown in table 15, there would be a shift from cattle operations to timber and hay production on over 80 percent of the remaining land in the 30-year flood plain above the level of the 3-year event. With the nonstructural project, the change in agricultural activities produces estimated annual disbenefits of $513,000 in decreased income for farm operators.

Non-agricultural flood damage reduction. A large portion of the non-agricultural flood losses occur to fences which are maintained to contain cattle operations to certain cleared and semi-wooded areas.

TABLE 15

NET PRODUCTIVITY PER ACRE
WITH AND WITHOUT NONSTRUCTURAL PLAN
(1974 price levels)

Activity	Acres	Unit Profit: Without Flooding	Total Return	Unit Flood Losses	Total Damages	Estimated Net Return
		Without Project				
Cattle operations	31,200	$38.38	$1,197,000	$30.94	$965,000	$232,000
		With Project				
Cattle operations	3,200	$38.38	$ 123,000	$30.94	$ 99,000	$ 24,000
Hay Production	12,700					
High management	(10,300)	45.23	466,000	17.99	185,000	281,000
Typical management	(2,400)	22.61	54,000	12.02	29,000	25,000
Timber	3,200	12.69	41,000	0	0	41,000
Total	19,100		$ 684,000		$313,000	$371,000
Net Differences			$ 513,000		$652,000	$139,000

With the nonstructural plan in operation, it is anticipated that some of these fences will be removed, in turn reducing flood losses. The need for these fenced areas will be reduced because the plan provides for lands in the habitat zone (3-year flood plain) to revert to natural habitat and lands in the cultivated zone (3- to 30-year flood plain) to be utilized for cultivated crops. Under without project conditions, cattle operations on the cleared and semi-wooded areas in these two zones encompass about 24,000 average annual inundated acres.

A synopsis of the method used to develop benefit estimates for reduced fence losses follows. That portion of the non-agricultural benefits claimed for fence losses, originally developed from damage surveys following floods in October through December 1971, totaled $1,023,500. The area inundated encompassed about 111,900 acres resulting in average damage of $9.15 per acre. Multiplying the average annual area inundated (24,000) acres by the unit damage per acre ($9.15) yields a total average annual fence damage of $219,600.

Investigations were made to ascertain the amount of fences required under without project conditions where the lands are used for grazing versus fencing with the lands in either natural habitat or in hay production. Typical fencing layouts for both conditions were prepared. Based on these analyses it is estimated that fencing requirements would be reduced by about 20 percent. The product of total annual fence damages ($219,600) times the estimated reduced losses of 20 percent would result in fence damage reduction benefits amounting to about $43,900 annually, based on 1974 price levels.

<u>Floodproofing benefits</u>. The final EIS noted that there were no habitable structures in the flood plain. Recent onsite investigations made in July 1980 revealed, however, that there were two small wood-framed houses within the 100-year flood plain. In addition, seven small farm buildings (hay sheds and barns) were identified during this survey. The two residences (including contents) are estimated to have a combined value of $24,300, based on 1974 price levels. The estimated 1974 value of the seven farm structures totaled about $33,000. These structures appeared to be fairly old and apparently have been in the flood plain a number of years. Thus, their remaining useful structural life is limited. Additionally, the farm buildings were found to be located in the upper fringe areas of the flood plain, slightly below the 100-year frequency flood elevation. Thus, potential flood losses to this group of buildings are minimal, estimated to average about $200 annually. Based on the above information, it was determined that it would not be economical to floodproof these structures.

The benefits claimed would result from the damages prevented or reduced by raising the residential structures in place and making the

necessary changes to the plumbing, wiring, and access. Average annual benefits were estimated to be equal to the total average annual damages prevented by raising each of the structures above the 100-year flood elevation. This essentially involved developing stage-damage relationships under existing conditions versus modified conditions with the structures raised. These stage-damage curves were then integrated with stage-frequency data to determine estimates of the floodproofing benefits. Average annual damages for existing conditions ($200) minus average annual damages with the two residences raised ($20) equals total average damages prevented (benefits) attributable to floodproofing the structures of $180 (rounded $200).

Recreation and fish and wildlife benefits. Recreation and fish and wildlife benefits credited to the Comprehensive Nonstructural plan are $795,000 and $31,700, respectively. Detailed development of these benefits is presented in Appendix D, Plan Formulation, Section IV.

Summary of Project Benefits

Table 16 presents a summary of average annual benefits creditable to the four alternatives considered in the detailed plan formulation studies on the Cooper Lake and Channels project. As shown, the average annual benefits for the recommended Reservoir Only plan are estimated at $5,043,100 based on July 1974 prices 3-1/4 percent interest rate, and a 100-year project life (1990-2089). These benefits would result from the project purposes previously described at the beginning of this section.

TABLE 16

SUMMARY OF PROJECT BENEFITS
(July 1974 prices & 3-1/4% interest rate)

Project Purpose	Reservoir & Levees (Final EIS Recommended Plan)	Reservoir Only (Supplemental EIS Recommended Plan)	Reservoir Water Supply Only	Comprehensive Nonstructural
Flood Control	$	$	$	$
Agricultural	375,000	294,000	0	652,000
Non-agricultural	301,000	176,000	0	44,100
Intensification	516,000	158,000	0	(513,000)
Storage exchange	113,000	113,000	0	0
Subtotal	$1,305,000	$ 741,000	0	$ 183,100
Water supply	2,671,500	2,671,500	2,671,500	0
Recreation	1,111,500	1,111,500	136,500	795,000
Fish & wildlife	255,200	269,400	132,500	31,700
Area redevelopment	293,200	249,500	208,400	0
Totals	$5,636,400	$5,042,900	$3,148,900	$1,009,800

APPENDIX C

SECTION III

RECOMMENDED PLAN 1980 ANALYSIS

Introduction

This section of the report documents the economic investigations and analyses made by FWD to reevaluate the benefits assignable to the recommended Cooper Lake project on the basis of 1980 conditions, prices, and current regulations. The results of investigations for the following benefit categories are presented herein:

- Flood Damage Reduction
- Agricultural Intensification
- Storage Exchange
- Recreation
- Water Supply
- Fish and Wildlife

Additionally, consideration was given to possible Area Redevelopment benefits that were claimed in previous studies. It was found that the affected study area no longer qualified for these types of benefits and, accordingly, were omitted.

Scope. The economic analysis conducted herein generally followed procedures set forth in current Corps of Engineers' regulations and Principles and Standards (P&S) established by the Water Resources Council. Key assumptions incorporated into these evaluations are as follows:

- Estimates of existing flood damages and benefits reflect March 1980 prices and level of development.
- The year 1990 was assumed to be the first year of operation for the plan investigated.
- The analysis period assumed a 100-year project life, extending from 1990 to 2089.
- The authorized Federal project interest rate of 3-1/4 percent was applied to convert future benefits to average annual equivalent values.

- The standard project flood was assigned the frequency of the 500-year event.

Plan investigated. These evaluations were limited to consideration of only one plan. This was the recommended Reservoir Only alternative selected as a result of detailed plan formulation studies made by FWD. Briefly, the project features provided for under this plan include 30-year flood protection for properties located downstream from the damsite, 273,000 acre-feet water supply storage, and 19,305 acres of water surface plus 3,300 acres of land for public recreation activities.

Methodology. In order to reevaluate flood control benefits assignable to the recommended plan, it was necessary, first, to determine current conditions in the flood plain and, second, to develop benefit estimates based on these conditions. The principal difference between the current investigations and those made previously pertained to the methodology chosen to develop estimates of flood damages and benefits. Previous estimates were derived through a historical series analysis. Conversely, flood frequency analyses were used for the 1980 flood control evaluations.

The major reason for changing to the frequency series was that it offered a simpler approach to computing average annual damages by weighting the effect of all floods without having to estimate the losses separately for each flood in a long series of events. This provided a more timely estimate over the historical series method. Review of the 1980 land use data showed that agricultural activities in the Sulphur River flood plain have changed measurably since the previous damage surveys were conducted. The frequency analysis alternative was adopted for use to estimate the effects of various flood events because historic records were not readily available to apply to the changed flood plain uses.

1980 Benefits - Reservoir Only Plan

This portion of the report describes the economic investigations and analyses made to determine the extent and need for flood control in flood plain lands along the Sulphur, and North and South Sulphur Rivers in Texas above the existing Wright Patman reservoir and below the proposed damsite for Cooper reservoir. The principal aim of these studies was to identify the flood problem in the affected study area and to determine the following:

- existing 1980 land uses and to identify the types and location of properties affected by flooding;

- current estimates of existing flood damages; and

- estimates of benefits attributable to the flood control component of the investigated plan.

As a result of these investigations, flood control benefits were developed for two categories, flood damage reduction and intensification.

Identification of the flood problem. A resurvey was made of the project area and follow-up office studies were conducted to determine 1980 economic and land use conditions in the Sulphur River flood plain. The basis for determining prevailing conditions and the results of these investigations are presented in subsequent paragraphs.

Mapping. Both aerial photography and US Geological Survey (USGS) mapping of the basin were referred to in the course of these studies. New aerial overflights were made of the study area. The aerial photographs reflected land use conditions as of March 1980. The base mapping used to delineate the flood plain areas consisted of 7-1/2 minute USGS quadrangle sheets.

Flood profiles and flood outlines. Water surface profiles for the 3-, 15-, 30-, 100-year and standard project flood (assumed 500-year) events under existing conditions were compiled for use in the economic evaluations. These profiles were used to delineate the limits of the flood plain and to establish the vertical control and/or the relationship of potential flood damageable properties to both elevation and frequency of occurrence.

Reach determinations. The flood plain was divided into three study reaches. Table 17 lists the reporting reaches utilized in the report and a description of their limits.

TABLE 17

REACHES FOR THE FLOOD CONTROL STUDIES

Reach	River Location	River Mile From	River Mile To
1	South Sulphur (damsite)	23.2	10.4
2	South Sulphur	10.4	0.0
	North Sulphur	3.6	0.0
	Sulphur	197.3	194.8
3	Sulphur	194.8	187.3

Field and office investigations. Field studies were conducted in March 1980. The area surveyed encompassed flood plain lands within the SPF limits along 37 miles of river: 10 miles along the Sulphur

River upstream from river mile 187.3 to its confluence with the North and South Sulphur Rivers at river mile 197.3; 23 miles along the South Sulphur upstream from that confluence to the proposed damsite, and 4 miles along the North Sulphur River upstream from the confluence. The major intent of these studies was to identify existing 1980 land uses and activities located in flood-prone areas along the river through on-site inspections and interviews.

Office investigations in April through June 1980 were conducted to develop more detailed data on existing crop patterns, yields, and other agricultural activities in the flood plain. This was achieved primarily through telephone interviews with farm operators, county agents, and with the Soil Conservation Service (SCS) of the Department of Agriculture, and the Texas Agricultural Extension Service of Texas A&M University System.

Land Use

Current land use activities within the Sulphur River Basin were determined from the base mapping and aerial photographs taken in March 1980. Five basic land use classifications were established: (a) cropland, (b) improved pasture, (c) native pasture, (d) woodland, and (e) water bodies. Classification of these land use activities was performed by an A-E consultant. The consultant's classifications were verified through on-site inspections by FWD personnel. The field investigations also developed more detailed delineation of specific crop acreages within the cropland category.

No urban development occurs in the surveyed area. Only a few well dispersed non-agricultural properties were observed within the SPF limits of the affected study area. The types and locations of these non-agricultural properties were found to be essentially the same as at the time of the previous study. A summary of existing 1980 land use activities within the SPF limits, by category and by reach, is presented in table 18.

TABLE 18

EXISTING (1980) LAND USE BY TYPE AND REACH WITHIN THE SPF LIMITS 1/

Reach	Cropland	Improved Pasture	Native Pasture	Woodland	Water Bodies	Total Area
	Land Use Type (acres)					
1	1,500	3,820	390	4,820	40	10,570
2	10,870	2,850	2,250	4,380	50	20,400
3	2,980	540	1.290	3,420	80	8,310
Totals	15,350	7,210	3,930	12,620	170	39,280
Percent of total	(39)	(18)	(10)	(32)	(less than 1)	(100)

1/ Does not include river channel or existing levee system

Comparative data for 1974 land use activities within the SPF limits were not compiled in earlier investigations. These land use data were collected, however, for activities within the 30-year flood plain. A comparison of land use activities in 1974 and 1980 is shown in table 19.

TABLE 19

COMPARISON OF 1974 AND 1980 LAND USE
COOPER LAKE PROJECT

Land Use Category	Land Uses in 30-year Flood Plain: 1974 Conditions 1/	1980 Conditions
	(in acres)	
Cleared		
Crop	0	11,720
Pasture	14,489	4,960
Wooded	16,351	14,160
Non-Usable 2/	769	769
Total	31,609	31,609

1/ Acreages from 1974 report adjusted on basis of slight deviation in planimeter measurement of total flood plain

2/ Includes river channel, existing levee system, and water bodies.

Three key observations are offered on findings generated from the existing (1980 land use study.

- Agriculture contines to be the main activity in flood prone areas of the Sulphur River Basin.

- A significant increase in the acreages committed to row crops has occurred since 1974.

- While the area of the standard project flood plain encompasses more than twice the area inundated by the 3-year flood, only small differences exist in the areas inundated by less frequent events.

Table 20 lists the estimated acreages flooded by various events as a percentage of the total area of the SPF.

TABLE 20

ESTIMATED AREAS INUNDATED BY
SELECTED FREQUENCY FLOOD EVENTS
(Existing 1980 Conditions)

Flood Event	Acres Flooded	Percent of SPF
3-year	16,630	(42)
15-year	28,670	(73)
30-year	31,609	(80)
100-year	36,260	(92)
SPF	39,280	(100)

Existing Agricultural Damages

Current estimates of damages and benefits were developed in order to account primarily for price adjustments and changes in agricultural activities in the Sulphur River basin that have occurred since 1974. This section of the report presents the economic analyses made to develop estimates of existing (1980) condition agricultural damages based on current land use, prices, and regulations.

Farm property other than crops located in the affected study area included fences and fewer than 20 farm residences and barns. The value of these structures was found to represent only a small portion of the overall agricultural investment in the flood plain. Field surveys revealed that no major additions or deletions of such structures have occurred since the 1971 damage evaluations. Accordingly, specific estimates of damages and benefits were not developed for farm properties other than crops. Damages for these types of properties are included in the non-agricultural benefit estimates.

Single occurrence flood damages. It is estimated that an SPF event could potentially cause damages of over $689 thousand in crop and pasture losses. Comparatively, a 30-year flood, which is less severe but more frequent event, would produce nearly $500 thousand in damages. Estimates of the flood losses given different single occurrence flood events, by reach, are presented in table 21.

TABLE 21

ESTIMATED SINGLE OCCURRENCE FLOOD LOSSES
FOR AGRICULTURAL ACTIVITIES
(1979 WRC normalized prices; 1980 level of development)

Reach	Flood Event: SPF	Flood Event: 100-year	Flood Event: 30-year
	($1,000)		
1	$150.1	$134.2	$113.1
2	417.3	389.5	351.8
3	122.0	117.7	33.9
Total	$689.4	$641.4	$498.8

Description of damage and benefit calculations. Selected curves and tables were prepared for use in estimating the annual flood damages and damages prevented (benefits). Generally, these curves and tables depicted the relationships between: stage and area inundated; stage and frequency of occurrence; area inundated and frequency of occurrence· composite crop loss estimates and area inundated versus frequency of occurrence. A brief description of each of these relationships follows:

- Stage-Area curves/tables. This relationship compares the land areas in a given reach that would be inundated given different flood stages.

- Stage-Frequency curves/tables. This curve gives the expected average interval in years between occurrences given different flood stages.

- Area-Frequency curves/tables. This relationship is determined through integration of the aforementioned curves and tables. The product yields an estimate of the average annual area inundated.

- Composite-Crop curves/tables. This table displays agricultural losses that could be expected to occur based on potential crop value losses per acre inundated. Estimates of the unit crop damage were developed using flood damage factors for application to gross crop values prepared by the Soil Conservation Service, US Department of Agriculture. As provided in current Corps regulations, crop values

were based on the latest available normalized prices contained in the Agricultural Price Standards published by the Water Resources Council. Potential losses in the total crop values and increased costs of production resulting from flooding were incorporated into the analysis in terms of crop damages. Both the seasonal variations of the crop value and probability of flooding were considered in calculating the average damage to a given crop. Adjustments also were made to account for the different types of crops grown in the flood plain. A percentage distribution was applied to the average damage of individual crops to form a composite unit crop damage value per acre.

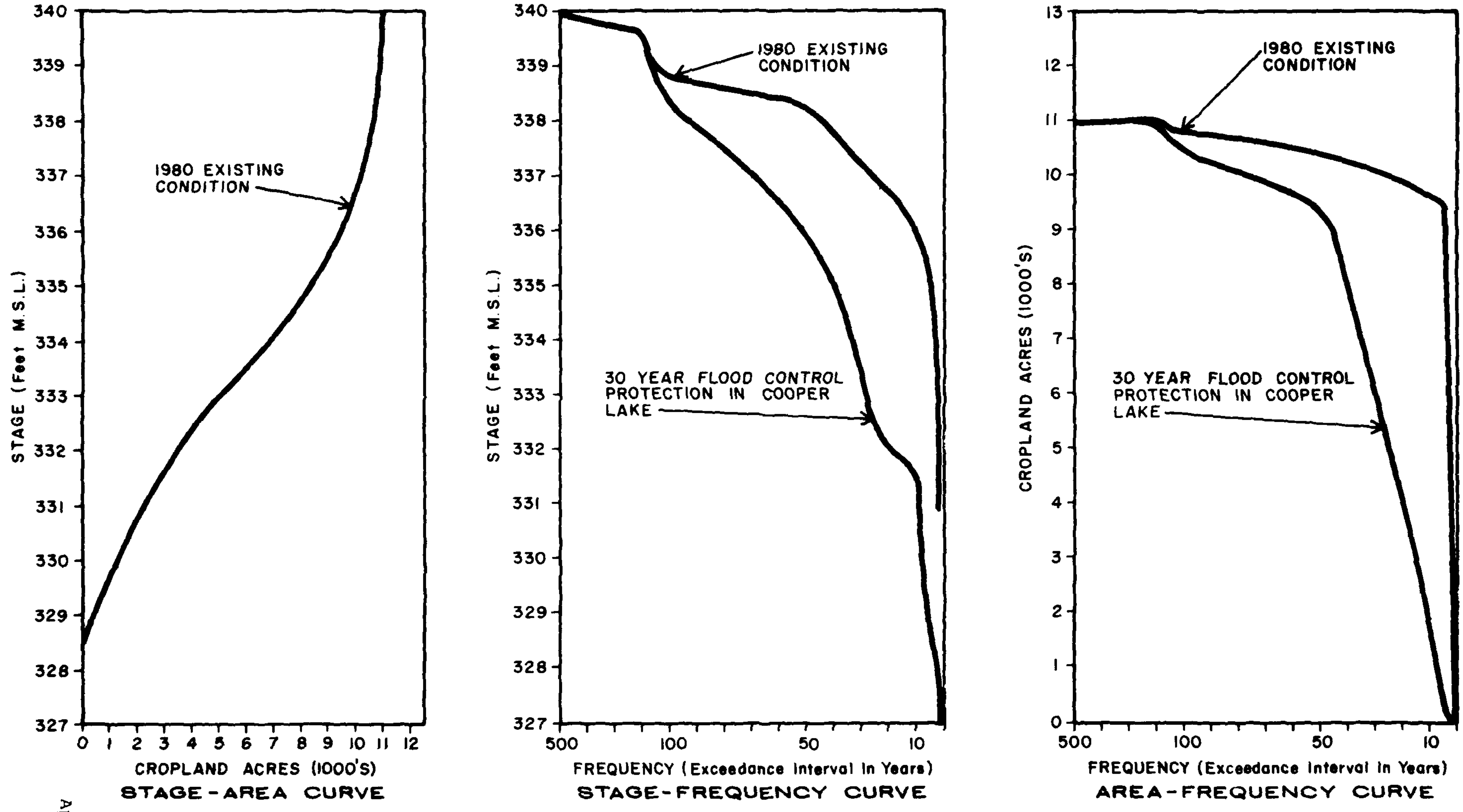
Area-frequency computations. Stage-area curves were developed for the three reaches along the Sulphur River flood plain. These stage-area curves show the area that would be inundated (in acres) given different levels of flooding. Area-frequency relationships were determined by integrating the stage-area curves with stage-frequency curves. Figure 1 illustrates the integration process of the curves for reach 2. Estimates of the average annual acres inundated were calculated for each of the reaches based on existing and modified conditions through the above comparisons. A summary of the estimated average annual acres flooded under existing conditions, the residual average annual acres flooded, and the average annual acres which would be prevented from flooding with the reservoir plan in operation is presented in table 22. These area-frequency relationships were then used to calculate the average annual damages and benefits accruing to croplands, pastureland, and semi-wooded lands located in the Sulphur River flood plain.

TABLE 22

ESTIMATED AVERAGE ANNUAL ACRES FLOODED
EXISTING AND MODIFIED CONDITIONS
(Existing 1980 conditions)

Reach	Estimated Average Annual Acres: Existing	Residual	Prevented
1	6,183	2,582	3,601
2	16,776	2,784	13,992
3	5,390	5,315	75
Totals	28,349	10,681	17,668

Annual crop damage computations. Composite crop data were derived which reflect the unit damages per acre of existing croplands inundated along the Sulphur River flood plain. Pertinent factors taken into account in calculating the unit crop damage per acre included the value and distribution of crops grown in the flood plain and seasonal variation in the crop values as they relate to flood damages and probability of flooding. As previously noted, crop values incorporated into the



COOPER LAKE
COMPUTATION OF AVERAGE ANNUAL DAMAGES AND BENEFITS
(REACH 2)

FIGURE 1
APPENDIX C

analysis were based on September, 1979, normalized prices as shown in the Water Resources Council publication entitled "Agricultural Price Standards," December 1979. Estimates of the annual yields of crops and pasture in the flood plain were based on averages of 1979 yields in the three principal flood plain counties (Lamar, Hopkins, and Delta) compiled by the Texas Crop and Livestock Reporting Service, and by field interviews with local county and Federal agricultural officials. Estimates of the percent distribution of various crops in the flood plain were made from stage-area curves developed for each crop in the flood plain from the current land use maps. The computations performed to determine the average value of crops grown in the flood plain is shown in table 23.

TABLE 23

ESTIMATED GROSS VALUE OF CROPS
SULPHUR RIVER FLOOD PLAIN
(1979 WRC normalized prices; average 1979 yields)

Crop	Unit	Yield per acre	Value per unit	Value per acre
Cotton	lb.	234	$ .513	$120.04
Hay, alfalfa	T.	2.8	51.36	143.81
Hay, all other	T.	2.6	51.36	133.54
Improved pasture	T.	4	51.36	205.44
Sorghum, grain	cwt.	27.5	3.74	102.85
Sorghum, forage	T.	1.2	51.36	61.63
Soybeans	bu.	24.6	5.66	139.24
Wheat	bu.	32.2	2.34	75.35
Wheat/Soy, double-cropped				214.59
Wheat	bu.	38.7	2.34	
Soybeans	bu.	12.7	5.66	
Native Pasture	T.	2.0	51.36	102.72
Wooded pasture	T.	0.3	51.36	15.40

Table 24 shows the estimated flood losses (shown as a percent of total value) that various crops would experience at different times of the year. These damage factors were compiled from data contained in an Economics Guide for Water Protection and Flood Prevention prepared by SCS. The percent-damage factors shown in table 24 gave consideration to the damages that would have occurred given different seasons and depths of flooding.

TABLE 24

PERCENT TOTAL ANNUAL VALUE DAMAGED BY FLOODING

Crop	Spring	Summer	Fall	Winter
Hay	20	22	12	2
Soybeans	32	43	44	7
Sorghum, grain	33	40	42	3
Wheat	50	1	21	35
Cotton	26	44	37	6
Alfalfa	27	19	11	6
Improved Pasture	19	35	19	3
Sorghum, forage	33	41	31	4
Wheat/Soy, double-cropped	16	12	10	12
Native Pasture	14	10	7	3
Wooded pasture	14	10	7	3

The percent-damage factors were then applied to the total estimated value of each of the crops grown in the flood plain to compute the adjusted seasonal value of the crops with flooding. Resultant values for the various crops are displayed in table 25. Also shown in the table is the estimated probability of flooding given different seasons of the year. This probability was derived based on a review of historical records of floods in the basin, using records from the Hagensport gage. The estimated unit crop damage per acre was then computed by comparing the value of the crops without flooding less the seasonal value of the crops with flooding, weighted by the probability of occurrence. The computation used for the Sulphur River flood plain is presented at the bottom of the table.

Composite unit crop damages. Estimates of the unit damages per acre for existing croplands inundated in each of the reaches analyzed were developed by multiplying the annual crop damage for each crop by its weighted average proportion of distribution in the flood plain as developed from the stage/area curves. The composite unit damage for cropland is presented in table 26. The annual unit damage for various types of pastureland were derived using separate stage/area curves and area-frequency relationships. This included separate damage estimates for native pasture, improved pasture, and pastured woodland. The unit damages per acre were multiplied times the average annual acres flooded to determine existing average annual damages for each category. The estimated number of average annual acres which continue to be flooded with the reservoir plan in operation was multiplied by the unit damages per acre to determine the remaining (residual) annual damages to existing agricultural lands. A summary of the existing average annual agricultural losses by reach is presented in table 27.

TABLE 25

ESTIMATED CROP VALUES WITH AND WITHOUT FLOODING
SULPHUR RIVER FLOOD PLAIN

Item	Without Flooding	With Flooding			
		Spring	Summer	Fall	Winter
Seasonal probability of flooding		32	5	23	40
Cotton	$120.04	$ 88.57	$ 66.62	$ 75.51	$112.24
Hay, alfalfa	143.81	105.15	116.98	128.18	134.58
Hay, other	133.54	106.69	103.49	116.77	130.43
Improved pasture	205.44	166.41	134.24	165.73	199.79
Sorghum, grain	102.85	68.68	62.05	73.60	99.51
Sorghum, forage	61.63	41.29	36.57	42.29	58.96
Soybeans	139.24	95.14	79.83	77.98	129.95
Wheat	75.35	36.59	74.85	59.69	48.98
Wheat/Soy, double-crop	214.59	181.11	187.79	193.33	188.22
Native pasture	102.72	88.58	92.79	95.08	99.38
Wooded pasture	15.40	13.28	13.91	14.26	14.90

AVERAGE FLOOD DAMAGES BY CROP

Cotton 0.32(120.04-88.57) + 0.05(120.04-66.62) + 0.23(120.04-75.51) + 0.40 (120.04-112.24) = $26.10 per acre

Hay, alfalfa 0.32(143.81-105.15) + 0.05(143.81-116.98) + 0.23(143.81-128.18) + 0.40(143.81-134.58) = $21.00 per acre

Hay, other than alfalfa 0.32(133.54-106.69) + 0.05(133.54-103.49) + 0.23 (133.54-116.77) + 0.40(133.54-130.43) = $15.19 per acre

Improved pasture 0.32(205.44-166.41) + 0.05(205.44-134.24) + 0.23(205.44-165.73) + 0.40(205.44-199.79) = $27.44 per acre

Sorghum, grain 0.32(102.85-68.68) + 0.05(102.85-62.05) + 0.23(102.85-73.0) + 0.40(102.85-99.51) = $21.04 per acre

Sorghum, forage 0.32(61.63-41.29) + 0.05(61.63-36.57) + 0.23(61.63-42.29) + 0.40(61.63-58.96) = $13.28 per acre

Soybeans 0.32(139.24-95.14) + 0.05(139.24-79.83) + 0.23(139.24-77.98) + 0.40(139.24-129.95) = $34.89 per acre

Wheat 0.32(75.35-36.59) + 0.05(75.35-74.89) + 0.23(75.35-59.69) + 0.40(75.35-48.98) = $26.58 per acre

Wheat/Soy 0.32(214.59-181.11) + 0.05(214.59-187.79) + 0.23(214.59-193.33) + 0.40(214.59-193.33) = $27.49 per acre

Native pasture 0.32(102.72-88.58) + 0.05 (102.72-92.79) + 0.23(102.72-95.08) + 0.40(102.72-99.38) = $8.12 per acre

Wooded pasture 0.32(15.40-2.12) + 0.05(15.40-1.49) + 0.23(15.40-1.14) + 0.40(15.40-0.50) = $1.21 per acre

TABLE 26
COMPOSITE UNIT CROP DAMAGES
SULPHUR RIVER FLOOD PLAIN
(Existing 1980 crop distributions)

Crop	Annual Damage per Acre	Reach 1		Reach 2		Reach 3	
		Distribution	Annual Loss	Distribution	Annual Loss	Distribution	Annual Loss
Cotton	$26.10	.13	$3.39	-	-	.03	$ .78
Hay, alfalfa	21.00	-	-	.05	$1.05	.02	.42
Hay, all other	15.19	.32	4.86	-	-	.12	1.82
Improved pasture	27.44	.24	6.58	-	-	-	-
Sorghum, grain	21.04	.01	.21	.17	3.58	-	-
Soybeans	34.89	.19	6.63	.36	12.56	.69	24.07
Wheat	26.58	.11	2.92	.24	6.38	.14	3.72
Wheat/Soy	27.49	-	-	.18	4.95	-	-
Totals		1.0	$24.59	1.0	$28.52	1.0	$30.81

TABLE 27

EXISTING AVERAGE ANNUAL FLOOD LOSSES
(March 1980 prices and development)

Item	Average Annual Damages: Reach 1	Reach 2	Reach 3	Total
	($1,000's)			
Crop	$ 11.6	$314.4	$ 6.8	$332.8
Improved pasture	38.4	38.8	5.2	82.4
Native pasture	1.2	13.1	11.4	25.7
Pasture woodland	5.0	3.3	4.4	12.7
Totals	$ 56.2	$369.6	$ 27.8	$453.6

Existing Inundation Reduction Benefits

This section describes the procedures used to estimate the existing National Economic Development (NED) benefits expected to result from implementation of the Reservoir Only plan. As previously noted, these analyses were conducted following the procedures setforth in current Corps of Engineers regulations.

Flood reduction benefits. Briefly, estimates of the inundation reduction benefits were calculated based on the damages to existing properties within the Sulphur River flood plain less the residual damages that would continue to occur with the reservoir in operation. A summary of the resulting flood reduction benefits by damage category and by reach is presented in table 28. With the recommended Reservoir Only plan in operation, agricultural flood losses along the Sulphur River would be reduced from $453.6 thousand to about $73.8 thousand annually. This potentially would eliminate over 80 percent of the annual agricultural flood losses.

TABLE 28

EXISTING AGRICULTURAL BENEFITS
FROM FLOOD DAMAGE REDUCTION

Item	Average Annual Benefits: Reach 1	Reach 2	Reach 3	Total
	($1,000's)			
Crop	$ 9.8	$294.7	$ 0.4	$304.9
Improved pasture	28.2	32.0	3.1	63.3
Native pasture	0.8	6.2	0	7.0
Woodland	2.5	2.1	0	4.6
FPOTC	62.9	168.7	54.4	286.0
Totals	$104.2	$503.7	$ 57.9	$665.8

Non-agricultural benefits. Benefit estimates for these properties were developed by adjusting to current dollars the non-agricultural benefits claimed in Supplement 1 to the General Design Memorandum, dated February 1977. A snyopsis of the method used to develop these benefits follows. The non-agricultural benefits were orginally developed from damage surveys following floods in October through December 1971. Estimates of total damages to non-agricultural properties were divided by total acreage flooded to obtain a composite figure of non-agricultural damage per acre. The product of this composite damage and estimates of average annual acres flooded with and without the reservoir yielded the existing damages and residual damages. The existing damages less the residual damages produced benefits of $176,000 based on 1974 conditions. An appropriate economic index was selected to update these benefits to reflect current conditions. The index selected was based on changes in prices paid to farmers as contained in the Survey of Current Business published by the U.S. Department of Commerce. The price index increased from 573 in July 1974 to 932 in March 1980, a factor of 1.626. In current dollars the benefits are estimated to be $286,000 (to the nearest thousand dollars). The updated estimate was apportioned among the three reaches on the basis of total existing average annual acres flooded in each reach.

Intensification Benefits

In addition to the flood reduction benefits claimed, intensification benefits are expected to be realized by agricultural producers in the flood plain. The proposed flood control improvements would allow for an intensified and more efficient use of these lands resulting from the reduced flood hazard.

Farm costs and income data were first analyzed for the rural areas to determine likely net income changes due to the flood control improvements. The methodology applied to calculate estimates of the net productive value per acre for crops grown in the flood plain under with project conditions is presented in table 29. Crop values were based on "normalized prices," as contained in the Water Resources Council publication entitled "Agricultural Price Standards," December 1979. Estimates of the net productive value of each type of crop grown in the flood plain was derived by subtracting the cost of crop production from the selling price, or gross value of the crop.

TABLE 29

NET PRODUCTIVE VALUE PER ACRE
SULPHUR RIVER FLOOD PLAIN

Crop	Gross Value	Cost to Produce 1/	Net Productive Value 2/	Relative Weight	Weighted Value
Cotton	$120.04	$ 90.56	$ 18.41	2%	$ 0.37
Hay, Alfalfa	143.81	73.56	59.12	8%	4.73
Hay, all others	133.54	82.73	39.74	7%	2.78
Soybeans	139.24	101.19	26.98	56%	15.11
Wheat/Soy	214.59	171.00	32.52	27%	8.78
Total				100%	$ 31.77
Loss in income from woodland					-10.16
Annual increase per acre in net productive value					$ 21.61

1/ From Texas A&M Crop Budgets, 1979-80, adjusted to reflect WRC normalized prices and flood plain yields.

2/ Excluding $11.07 conversion cost

Cropping practices were determined for with and without project conditions using historic agricultural census data and from information obtained through interviews with local farmers and knowledgeable agricultural representatives. No further increase in crop or improved pasturelands is expected in the future without project conditions. Under improved conditions, however, it was assumed that the reduced threat of flooding would permit conversion of available land into higher valued crops. Recent trends in the area show conversion of other agricultural lands into cropland presently is occurring. Interviews with farm operators affirmed that conversion was being made for two principal reasons: (1) favorable market conditions; and, (2) the assumption that the proposed flood control works would provide additional flood protection, particularly to lands located behind the existing levee system.

For the intensification benefit calculations, lands available for conversion to cropland were assumed to consist of wooded acreages in the 30-year flood plain although it is possible that some pasture and cropland will also be converted to higher valued crops. Land available for conversion was restricted to woodland areas located in reach 2 behind levee 5RSS. The future with project crop distribution was assumed to consist of existing crop acreages with projected positive net income in protected portions of the Sulphur River flood plain. The assumed crop percentages under with project conditions are shown in table 29. These crop percentages were multiplied by the net productive value of each crop to derive an average net productive value per acre.

Agricultural activities modifying their operations due to the reduced potential for flooding would have to incur certain conversion costs in order to achieve higher levels of production. This would involve the costs to clear the woodlands, prepare the fields, and construct roads and related facilities. Based on data obtained from interviews with local county agents, it is estimated that costs of approximately $150 per acre would typically be incurred to convert the woodlands to croplands. This first cost, when capitalized, amounts to an annual cost of $11.07. This annual conversion cost was deducted to estimate the net productive value of the croplands converted and the resultant intensification benefits creditable to the project.

Since 1974, a total of 11,720 acres have been converted to crops in protected portions of the existing levee system along the Sulphur River flood plain. On an annual basis, this has amounted to 1950 acres being converted yearly. Interviews with farm operators formed the basis for concluding that an additional 849 acres of woodland would be converted to cropland by the first year of the project. As previously noted, such conversion will not occur without the expectation of reduction in flood hazard to be produced by the Reservoir Only plan. The estimated increase in agricultural net income ($21.61/acre) was applied to 849 acres for an annual increase of $18,300. Increased residual average annual damages to the higher valued crops in the intensified area were estimated at $1,400 and was subtracted from the anticipated increased agricultural income, resulting in a net intensification benefit claimed of $16,900.

Storage Exchange Benefits

These benefits would result from the conversion of 120,000 acre-feet of flood control storage at Wright Patman Lake to municipal and industrial water supply space. About 131,400 acre-feet of flood control storage would be provided in Cooper Lake to allow for this transfer. The flood control benefits previously attributable to Wright Patman Lake would be shifted to Cooper Lake in view the latter reservoir would then provide the flood protection to properties downstream of Wright Patman.

Flood control storage benefits previously claimed for the Cooper project amounted to $113,000 annually, based on 1974 price levels. These benefit estimates were updated through an indexing process which adjusted the price level increases of benefits since July 1974 to reflect March 1980 price levels. Again, this was done to place the benefit estimates on a current basis with the project cost data. Changes in the "prices received by farmers" as contained in the Survey of Current Business published by the U.S. Department of Commerce was selected as an appropriate index to update the 1974 flood damage reduction benefits

to crops and agricultural intensification benefits claimed. Changes in this price index over the period specified and the resulting factor of increase are shown below:

Benefit Category	Price Index July 1974	Price Index March 1980	Factor of Increase
Crops & Agricultural Intensification	475	586	1.234

Using the above price level adjustment factor, the storage exchange benefits were updated to March 1980 price levels. Resultant annual benefits claimed for the recommended Reservoir Only plan amounted to $139,00 (rounded).

Water Supply Benefits

The average annual water supply benefits of $2,893,600 for Cooper Lake at July 1974 prices were updated for the purpose of evaluating the project at March 1980 prices and conditions. The updating involved indexing costs to the March 1980 level for both the alternative water supply lake and fish and wildlife compensation measures. Using 3-1/4 percent as the Federal interest rate in accordance with Section 80 of the 1974 Water Resources Development Act, computation of water supply benefits at the March 1980 price levels would be as follows:

FIRST COST	
Single purpose water supply lake (109 mgd)	$ 88,523,000
Compensation of fish and wildlife losses	12,553,000
Total First Cost	$101,076,000
INVESTMENT	
Total first cost	$101,076,000
Interest during construction (4 years @ 4%)	8,086,000
Total Investment	$109,162,000
AVERAGE ANNUAL BENEFITS	
Equivalent annual payments for 25 years @ 4% $109,162,000 x 0.064012 =	$ 6,987,700
Equivalent investment at 3¼% Federal rate $6,987,700 x 16.937863 =	118,356,700
Equivalent annual cost for 100 years @ 4% $118,356,700 x 0.033884 =	4,010,400
Annual operation, maintenance, & replacement for lake =	283,600
Annual operation and maintenance for fish & wildlife compensation =	118,600
Total Average Annual Water Supply Benefits	$ 4,412,600

The appropriate FY 1981 interest rate for evaluating Federal water resources projects not affected by Section 80 of the 1974 Water Resources Development Act is 7-3/8 percent. Comparable non-Federal financing would be 7-1/2 percent for 30 years. As a sensitivity check, average annual water supply benefits at the March 1980 price level were recomputed using these interest rates and bonding period. The results follow,

FIRST COST	
Single purpose water supply lake (109 mgd)	$88,523,000
Compensation of fish and wildlife losses	12,553,000
Total First Cost	$101,076,000
INVESTMENT	
Total first cost	$101,076,000
Interest during construction (4 years @ 7½%)	15,161,000
Total Investment	$116,237,000
AVERAGE ANNUAL BENEFITS	
Equivalent annual payments for 30 years @ 7½%	
$116,237,000 x 0.084671 =	$ 9,841,900
Equivalent investment at 7-3/8% Federal rate	
$9,841,900 x 11.955556 =	117,665,400
Equivalent annual cost for 100 years @ 7-3/8%	
$117,665,400 x 0.073810 =	8,684,900
Annual operation, maintenance, and replacement for lake	283,600
Annual operation and maintenance for fish and wildlife compensation	118,600
Total Average Annual Water Supply Benefits	$ 9,087,100

Recreation/Fish and Wildlife Benefits

Cooper Lake was authorized prior to the enactment of the Federal Water Project Recreation Act, Public Law 89-72 (1965) and, therefore, recreation development is being provided pursuant to Section 4 of the 1944 Flood Control Act, Public Law 78-534. The project is being planned to provide facilities to take care of the initial recreation use. No future development is planned because it would require a local cost sharing sponsor. The benefits claimed are those expected to result from the development of these initial facilities. Benefits were calculated by assigning values to various activities in accordance with guidance contained in Supplement 1 to Senate Document No. 97. The methodology applied to compute estimates of the recreation benefits is summarized in the following paragraphs. Detailed information on the 1980 recreation analysis is presented in Section VII, Appendix D.

Methodology for computing recreation benefits. The market area used in estimating recreation use for Cooper Lake (recommended plan under

1980 conditions) included those counties whose population centers lie within 100 road miles of the nearest point of access to any element of the system. The recreation uses assignable to these improvements were adjusted to allow for the influence of other competing projects. The main factors considered in determining recreational usage were the estimated population for the market area and the per capita use rates developed for the project.

Estimates of recreation participation were based on detailed economic investigations, information obtained from the Texas Outdoor Recreation Plan (TORP), recent Heritage Conservation and Recreation Service publications, and other available data. New per capita use rates were developed for Cooper Lake for the 1980 recreation analysis based on use by Canton Lake in the Tulsa District and Somerville and Whitney Lakes in the Fort Worth District (see Figure 9 of Appendix D). Forecasts of population and per capita incomes for the recreational market area were obtained from OBERS Series "E" projections. The findings, based on the methodology for estimating recreation use, are in agreement with the TORP. Recreational use estimates are summarized in table 30.

TABLE 30

ESTIMATES OF ANNUAL RECREATIONAL USE
(Expressed in recreation days)

Feature	Initial
Cooper Lake	
General recreation	1,172,140
Sport fishing	192,202
Sport hunting	4,658
Total	1,369,000

Summary of recreation benefits. The general recreation benefits expected to result from the development of public use facilities are based upon projected initial recreational use and the day use unit value for the activity. The initial and future fish and wildlife benefits were converted to average annual values based on an interest rate of 3-1/4 percent with a 100-year project life (1990-2089). The total average annual fish and wildlife benefits consist of the initial benefit plus the discounted future benefits. A summary of the average annual equivalent values is presented in table 31.

TABLE 31

RECREATION AND FISH AND WILDLIFE BENEFITS
Average Annual Equivalent Values
(1980 Analysis)

Activity	Benefit (Rounded)
General recreation	$1,758,000
Sport fishing	285,000 1/
Sport hunting	0 2/
Commercial fishing (potential)	30,000
Total	$2,073,000

1/ Includes a loss of $3,381 in stream fishing inundated by Cooper Lake (see Section VII of Appendix D).

2/ Net monetary sport hunting losses for the Reservoir Only Plan without mitigation are 8,841 man-days with a value of $22,700. The Corps recommended mitigation plan will offset these sport hunting losses. Therefore, net benefits for sport hunting are zero for the selected plan including the recommended terrestrial habitat mitigation (see Section II of Appendix D).

Commercial fish and wildlife benefits. The proposed terrestrial mitigation area will offset $4,816 in potential commercial pelt value loss (1978-79 fur season value) for 8 species of fur bearers. Therefore, there are no net benefits claimed for trapping. The lake will support 64,720 pounds of commercial fishing. Stream commercial losses due to inundation will be about 5,600 pounds, for a net gain of about 59,120 pounds. At an estimated value of $0.50/lb. at 1980 price levels. this results in a commercial fishing benefit of $29,560.

Summary of Project Benefits

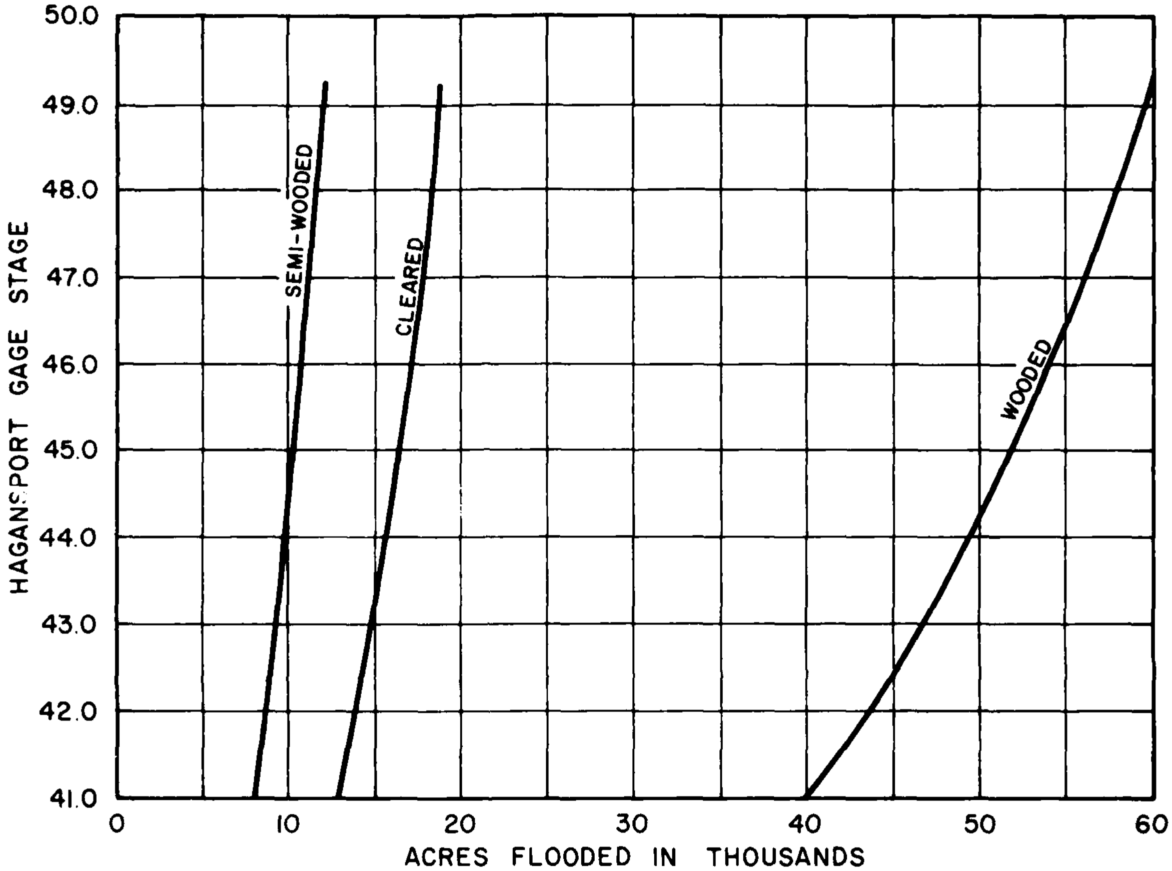
Table 32 presents a summary of the average annual benefits creditable to the recommended Reservoir Only plan. As shown, the average annual benefits are estimated to be about $7.3 million, based on March 1980 prices, 3-1/4 percent interest rate, and a 100-year period of analysis (1990-2089). These benefits consist of flood control storage exchange, water supply, recreation, and fish and wildlife.

TABLE 32

SUMMARY OF PROJECT BENEFITS
(March 1980 prices @ 3-1/4 percent)

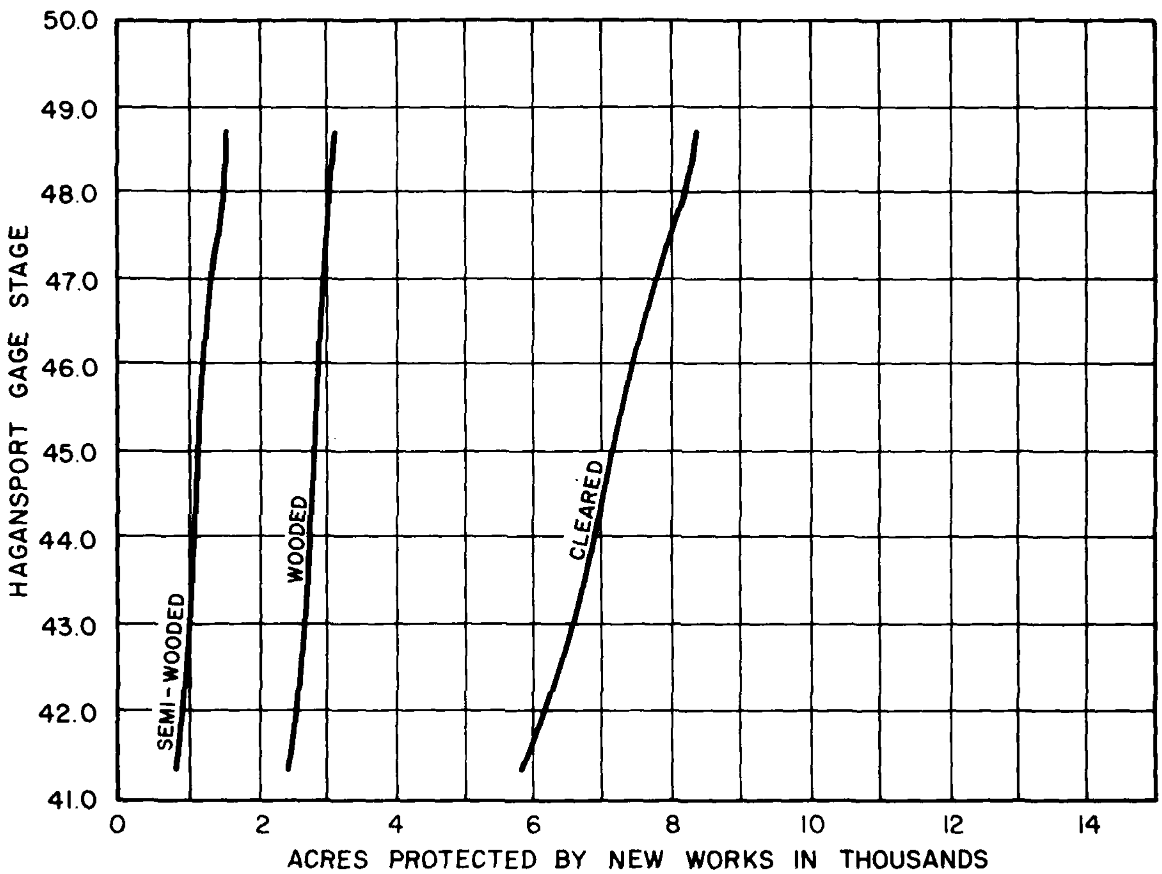
Annual Benefits	
Flood Damage Reduction	
Agricultural	$ 379,800
Non-agricultural	286,000
Intensification	
Agricultural	16,900
Flood Control Storage Exchange	139,000
Water Supply	4,412,600
Fish and Wildlife	315,000
General Recreation	1,758,000
Total	$7,307,300

EXHIBITS



STAGE AREA CURVE
FOR
STATUS QUO CONDITION

EXHIBIT I

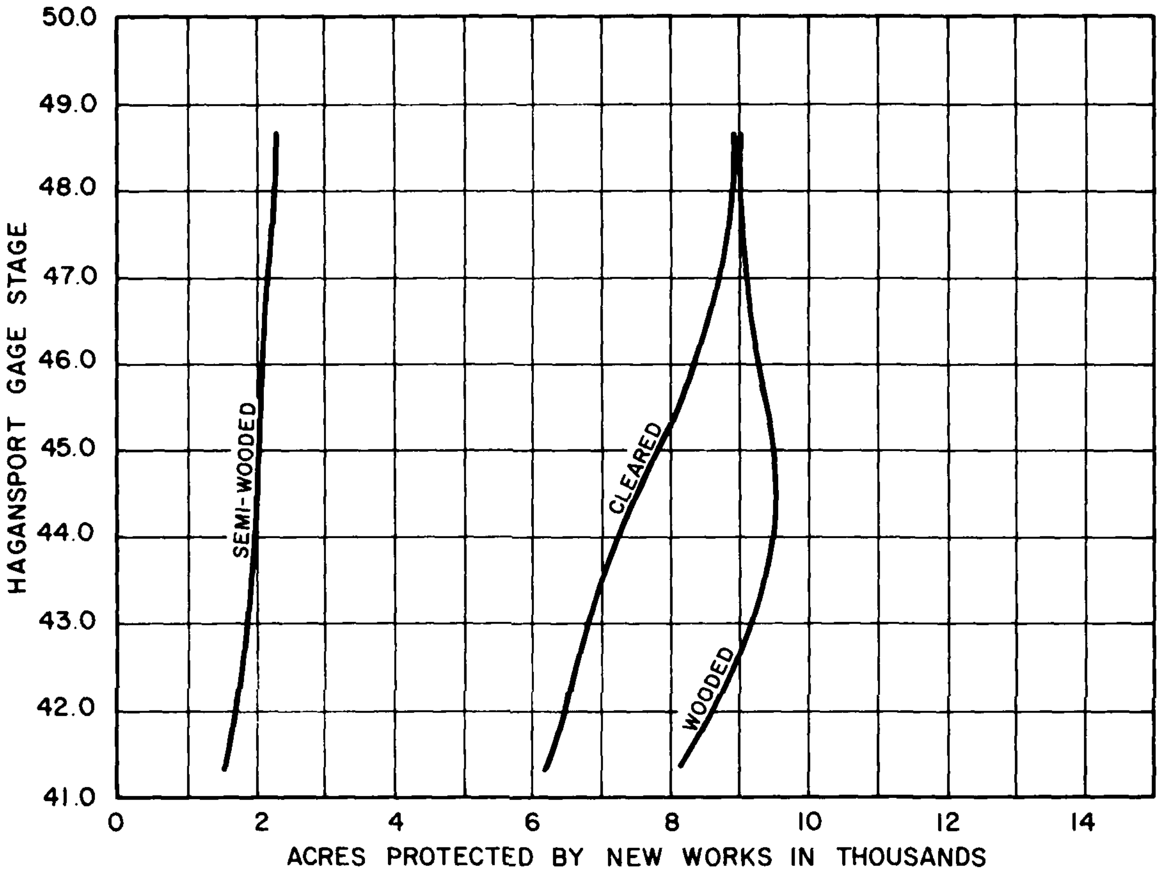


STAGE AREA CURVE

FOR

RESERVOIR ONLY ALTERNATIVE

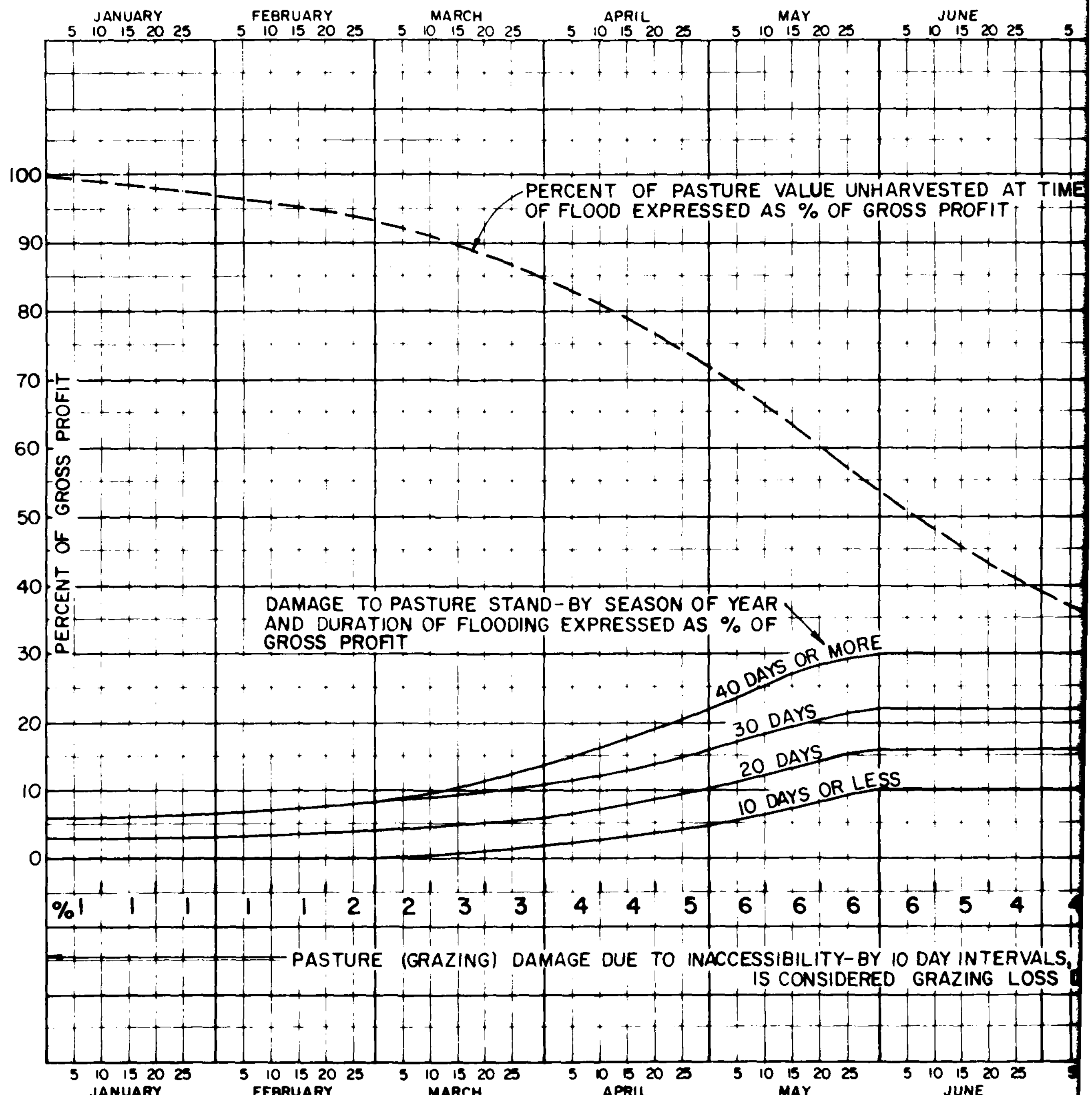
EXHIBIT 2



STAGE AREA CURVE
FOR
RESERVOIR AND LEVEES ALTERNATIVE

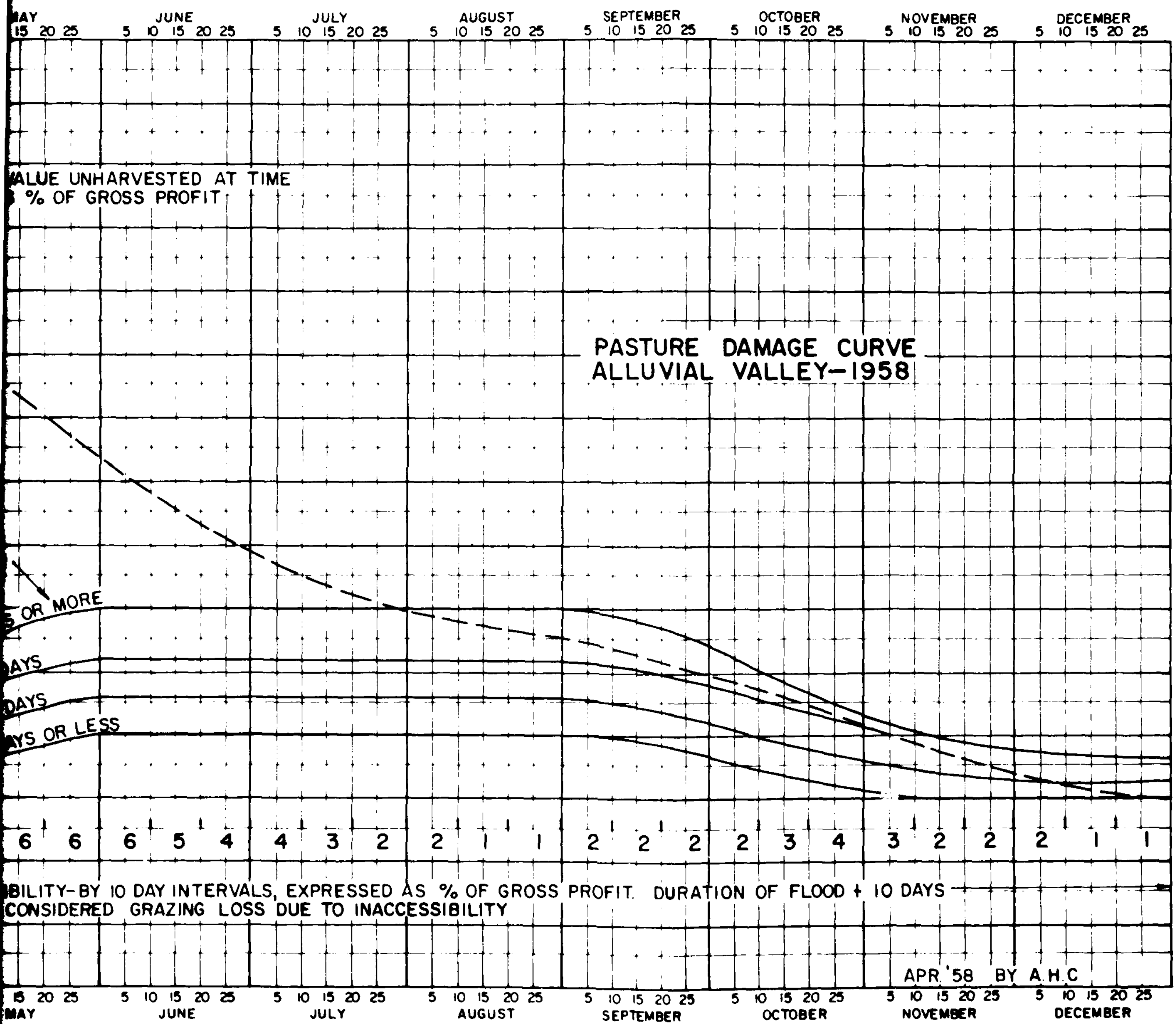
EXHIBIT 3

EXHIBIT



JANUARY FEBRUARY MARCH APRIL MAY JUNE
5 10 15 20 25
PERCENT OF GROSS PROFIT
100 90 80 70 60 50 40 30 20 10 0
PERCENT OF PASTURE VALUE UNHARVESTED AT TIME OF FLOOD EXPRESSED AS % OF GROSS PROFIT
DAMAGE TO PASTURE STAND-BY SEASON OF YEAR AND DURATION OF FLOODING EXPRESSED AS % OF GROSS PROFIT
40 DAYS OR MORE
30 DAYS
20 DAYS
10 DAYS OR LESS
% 1 1 1 1 1 2 2 3 3 4 4 5 6 6 6 6 5 4
PASTURE (GRAZING) DAMAGE DUE TO INACCESSIBILITY-BY 10 DAY INTERVALS,
IS CONSIDERED GRAZING LOSS

EXHIBIT 4



APPENDIX C

EXHIBIT 5

POTENTIAL AGRICULTURAL DAMAGE
"STATUS QUO" CONDITIONS

Year	Date of Flood Peak	Historic Stage (Hagansport)	Flood Duration	Acres Protected by New Works: Cleared	Acres Protected by New Works: Semi-Wooded	Acres Protected by New Works: Total Usable	Damage Prevented by New Works: % Lost Grazing	Damage Prevented by New Works: % of Stand	Damage Prevented by New Works: Production Loss/Acre*	Total Damages
1945	Feb. 28	42.1	Feb. 21-Mar. 4	14,250	8,750	23,000	4	0	$ 3.51	$ 80,730
	Mar. 31	45.1	Mar. 29-Apr. 3	16,800	10,250	27,050	6	2	7.02	189,891
	June 13	42.6	June 12-June 17	14,750	9,050	23,800	7	10	14.91	354,858
	Oct. 10	41.5	Oct. 9-Oct. 12	13,750	8,400	22,150	4	4	7.02	155,493
1946	June 2	41.4	May 15-June 4	13,500	8,200	21,700	17	16	28.95	628,215
	Nov. 6	45.1	Nov. 3-Nov. 11	16,800	10,250	27,050	5	0	4.39	118,750
1947	May 1	41.8	Apr. 30-May 4	13,950	8,500	22,450	8	6	12.28	275,686
1948	Jan. 2	42.2	Jan. 1-Jan. 5	14,300	8,800	23,100	2	0	1.75	40,425
	May 12	41.0	May 11-May 19	13,000	8,000	21,000	12	8	17.54	368,340
1949	Jan. 23	42.1	Jan. 25-Feb. 1	14,250	8,750	23,100	2	0	1.75	40,425
	Feb. 25	42.1	Feb. 24-Feb. 28	14,250	8,750	23,100	3	0	2.63	60,490
1950	Feb. 13	43.2	Feb. 2-Feb. 17	15,250	9,250	24,500	4	2	5.26	128,870
	May 3	41.4	May 1-May 17	13,500	8,200	21,700	15	11	22.81	494,977
	Sept 17	41.2	Sept 15-Sept 23	13,200	8,100	21,300	4	9	11.40	242,820
1951	June 13	42.2	June 4-June 19	14,300	8,800	23,100	12	13	21.93	506,583
1952	Apr. 23	43.4	Apr. 12-Apr. 27	15,700	9,600	25,300	12	7	16.67	421,751
	May 19	41.0	May 19-May 27	13,000	8,000	21,000	11	9	17.54	368,340
1953	Apr. 30	43.8	Apr. 29-May 19	15,900	9,800	25,700	17	14	27.19	698,783
1954	May 13	42.6	May 10-May 15	14,750	9,050	23,800	9	7	14.04	334,152
	Oct. 25	41.0	Oct. 23-Nov. 5	13,000	8,000	21,000	7	4	9.65	202,650
1955	Mar. 21	41.0	Mar. 21-Mar. 24	13,100	8,050	21,150	4	1	4.39	92,849
	Apr. 13	41.0	Apr. 13-Apr. 15	13,000	8,000	21,000	6	3	7.89	165,690
1956	Feb. 18	41.8	Feb. 17-Feb. 20	13,950	8,500	22,450	2	0	1.75	39,288
	May 2	41.7	May [illegible]-May 5	13,900	8,450	22,350	8	6	12.28	274,458
1957	Apr. 27	43.4	Mar. 18-June 12	15,[illegible]	9,[illegible]	25,300	47	30	67.54	1,708,762
1958	Feb. 21	1.3	Feb. 14-Feb. 24	13,3[illegible]	[illegible],300	21,[illegible]	4	0	3.51	75,816
	Mar. [illegible]	41.3	Mar. 4-Mar. 14	[illegible]	[illegible]	21,[illegible]	5	1	5.26	113,616
	May 3	45.5	Apr. 26-May 9	[illegible]	[illegible]	27,55[illegible]	13	8	18.42	507,471
1959	Feb. 15	41.6	Feb. 14-Feb. 16	[illegible]	[illegible]	[illegible]	2	0	1.75	38,850
	Apr. 18	41.0	Apr. 17-Apr. [illegible]	[illegible]	[illegible]	[illegible]	7	4	9.65	202,650
	June 24	42.5	June 21-June [illegible]	[illegible]	[illegible]	[illegible]	6	10	14.04	331,344
	July 27	42.0	July 24-July [illegible]		[illegible]	[illegible]	3	10	11.40	259,920
	Oct. 6	41.1	Oct. 5-Oct. [illegible]				3	5	7.02	148,473
	Nov. 5	41.7	Nov. 4-Nov. [illegible]				3	1	3.51	78,448
	Dec. 17	43.7	Dec. 15-Dec. [illegible]				1	0	0.88	22,352
1960	Jan. 7	42.8	Jan. [illegible]-Jan. [illegible]				3	0	2.63	63,383
	Feb. 5	41.8	Feb. [illegible]-Feb.				2	0	1.75	39,288
	Mar. 26	41.1	Mar. 25-Mar.				[illegible]	1	3.51	74,236
	June 13	41.5	June 12-June [illegible]				[illegible]	10	14.91	325,038
	July 6	42.3	July [illegible]-July				[illegible]	10	[illegible]	286,124
	Sept 27	42.4	Sept 6-Sept [illegible]					[illegible]	[illegible]	205,657
	Oct. 6	42.4	Oct. 5-Oct. [illegible]					[illegible]	[illegible]	205,657
	Oct. 29	42.0	Oct. 28-Oct. [illegible]						[illegible]	139,992
	Dec. 8	44.[illegible]	Dec. 4-Dec. [illegible]						[illegible]	68,840
1961	Feb. 7	42.0	Feb. 7-Feb.							[illegible]
	Mar. 30	43.4	Mar. 27-Apr. [illegible]							[illegible]
	Nov. 23	42.2	Nov. 23-Nov. [illegible]						[illegible]	[illegible]
	Dec. 10	42.4	Dec. 10-Dec. [illegible]							[illegible]

Year	Date of Flood Peak
1962	Jan. 27
	Feb. 24
	Mar. 31
	May 1
	June 30
	Sept 3
	Nov. 28
1963	Jan. 5
	Mar. 12
	Apr. 29
1964	Mar. 10
	Apr. 24
	May 9
	June 2
	Sept 22
	Nov. 20
1965	Feb. 10
	May 11
1966	Feb. 10
	May 1
	May 24
	Oct. 5
1967	June 2
	July 7
	Oct. 30
	Dec. 15
1968	Jan. 31
	Mar. 21
	June 12
	July 30
	Sept 1[illegible]
	Nov. 2[illegible]
	Dec. 22
1969	Jan. 3[illegible]
	May 9
	Oct. 3[illegible]
	Dec. [illegible]
	Dec. 2[illegible]
1970	Mar. [illegible]
	Apr. 2[illegible]
	Oct. 1[illegible]
	Nov. 1[illegible]
1971	Feb. 2[illegible]
	Aug. 1[illegible]
	Oct. 2[illegible]
	Dec. 1[illegible]

GRAND TOTAL

AVERAGE ANNUA[illegible]

*Based on wei[illegible]

...ted by New Works ...f ...nd	Production Loss/Acre*	Total Damages
[illegible]	$ 3.51	$ 80,730
[illegible]	7.02	189,891
[illegible]	14.91	354,858
[illegible]	7.02	155,493
[illegible]	28.95	628,215
[illegible]	4.39	118,750
[illegible]	12.28	275,686
0	1.75	40,425
[illegible]	17.54	368,340
0	1.75	40,425
0	2.63	60,470
2	5.26	128,870
1	22.81	494,977
[illegible]	11.40	242,820
3	21.93	506,583
7	16.67	421,751
9	17.54	368,340
4	27.19	698,783
7	14.04	334,152
4	9.65	202,650
1	4.39	92,849
3	7.89	165,690
0	1.75	39,288
6	12.28	274,458
0	67.54	1,708,762
0	3.51	75,816
1	5.26	113,616
8	18.42	507,471
0	1.75	38,850
4	9.65	202,650
0	14.04	331,344
0	11.40	259,920
5	7.02	148,473
1	3.51	78,448
0	0.88	22,352
0	2.63	63,383
0	1.75	39,288
1	3.51	74,236
0	14.91	325,038
0	12.28	286,124
7	8.77	205,657
6	8.77	205,657
2	6.14	139,992
0	2.63	68,840
7	10.53	240,084
2	7.89	199,617
0	4.39	101,409
0	1.75	41,018

EXHIBIT 5

POTENTIAL AGRICULTURAL DAMAGES "STATUS QUO" CONDITIONS

Year	Date of Flood Peak	Historic Stage (Hagansport)	Flood Duration	Acres Protected by New Works: Cleared	Semi-Wooded	Total Usable	Damage Prevented by New Works: % Lost Grazing	% of Stand	Production Loss/Acre*	Total Damages
1962	Jan. 27	42.9	Jan. 26-Jan. 30	15,050	9,250	24,300	1	0	0.88	21,384
	Feb. 24	41.6	Feb. 24-Mar. 1	13,800	8,400	22,200	3	0	2.63	58,386
	Mar. 31	42.4	Mar. 31-Apr. 3	14,500	8,950	23,450	6	3	7.89	185,021
	May 1	42.6	Apr. 27-May 4	14,750	9,050	23,800	16	8	21.05	500,990
	June 30	42.8	June 28-July 3	[illegible]	9,100	24,100	6	10	14.04	338,364
	Sept 3	41.8	Sept 2-Sept 13	[illegible]	8,500	22,450	4	11	13.16	295,442
	Nov. 28	43.9	Nov. 22-Dec. 7	15,900	9,800	25,700	4	1	4.39	112,823
1963	Jan. 5	42.7	Jan. 5-Jan. 9	[illegible]	9,100	23,900	1	0	0.88	21,032
	Mar. 12	41.7	Mar. 12-Mar. 19	[illegible]	[illegible]	22,350	3	0	2.63	58,781
	Apr. 29	42.4	Apr. 28-May 2	[illegible]	8,950	23,450	7	5	10.53	246,929
1964	Mar. 10	42.8	Mar. 10-Mar. 12	[illegible]	9,100	24,100	3	1	3.51	84,591
	Apr. 24	43.2	Apr. 22-Apr. 30	[illegible]	9,400	24,700	10	4	12.28	303,316
	May 9	41.9	May 9-May 11	[illegible]	8,750	22,750	6	6	10.53	239,558
	June 2	44.0	May 31-June 21	[illegible]	[illegible]	25,900	15	16	27.19	704,221
	Sept 22	41.7	Sept 22-Sept 26	[illegible]	8,450	22,350	3	8	9.65	215,678
	Nov. 20	43.9	Nov. 19-Nov. 23	[illegible]	[illegible]	25,700	3	0	2.63	67,591
1965	Feb. 10	46.6	Jan. 9-Feb. 28	[illegible]	[illegible]	[illegible]	8	8	14.04	405,756
	May 11	45.8	May 11-June 1	[illegible]	[illegible]	[illegible]	14	18	28.07	783,153
1966	Feb. 10	44.3	Feb. 10-Feb. 13	[illegible]	10,000	26,100	1	0	0.88	22,968
	May 1	48.9	Apr. 23-May 6	[illegible]	12,000	31,000	14	6	17.54	543,740
	May 24	43.7	May 24-May 26	[illegible]	8,700	25,400	7	9	14.04	356,616
	Oct. 5	43.3	Oct. 5-Oct. 7	[illegible]	9,400	24,800	3	5	7.02	174,096
1967	June 2	45.7	Apr. 11-June 5	[illegible]	10,600	27,800	35	24	51.75	1,438,650
	July 7	42.4	July 5-July 7	[illegible]	9,950	23,450	4	10	12.28	287,966
	Oct. 30	45.4	Oct. 17-Nov. 5	[illegible]	10,400	27,400	7	7	12.28	336,472
	Dec. 15	44.6	Dec. 15-Dec. 24	[illegible]	9,050	25,450	2	0	1.75	44,538
1968	Jan. 31	43.7	Jan. 23-Feb. 3	[illegible]	9,700	25,400	2	0	1.75	44,450
	Mar. 21	46.0	Mar. 9-May 3	[illegible]	10,700	28,100	27	17	38.60	1,084,660
	June 12	45.6	June 12-June 30	[illegible]	10,500	27,600	12	13	21.93	605,268
	July 30	44.0	July 24-Aug. 3	[illegible]	[illegible]	25,900	4	10	12.28	318,052
	Sept 18	44.4	Sept 10-Sept 21	[illegible]	10,000	26,200	4	10	12.28	321,736
	Nov. 28	45.1	Nov. 27-Dec. 6	[illegible]	[illegible]	27,100	4	0	3.51	95,121
	Dec. 22	45.2	Dec. 22-Dec. 30	[illegible]	[illegible]	27,200	2	8	8.77	238,544
1969	Jan. 31	46.7	Jan. 30-Mar. 19	[illegible]	11,000	28,950	21	14	30.70	888,765
	May 9	46.3	May 6-May 31	[illegible]	10,800	26,500	4	1	4.39	[illegible],115
	Oct. 31	41.1	Oct. 31-Nov. 3	[illegible]	8,350	21,150	2	0	1.75	37,013
	Dec. 8	42.1	Dec. 6-Dec. 11	[illegible]	8,750	23,000	1	0	0.88	20,240
	Dec. 29	46.0	Dec. 29-Jan. 4	[illegible]	10,750	28,150	1	0	0.88	24,772
1970	Mar. 1	46.1	Feb. 2-Mar. 28	[illegible]	10,800	28,300	15	10	21.93	620,619
	Apr. 26	46.8	Apr. 18-May 6	[illegible]	11,000	29,000	15	10	21.93	635,970
	Oct. 14	45.6	Oct. 12-Oct. 28	17,100	10,500	27,600	8	6	12.28	338,928
	Nov. 14	44.6	Nov. 14-Nov. 18	[illegible]	9,050	25,450	3	3	5.26	133,867
1971	Feb. 22	41.2	Feb. 22-Feb. 24	[illegible]	8,100	21,300	3	0	2.63	56,019
	Aug. 15	45.5	Aug. 15-Aug. 18	[illegible]	10,450	27,500	1	10	9.65	265,375
	Oct. 21	47.0	Oct. 4-Oct. 31	[illegible]	11,000	29,050	11	13	21.05	611,503
	Dec. 11	50.6	Dec. 3-Dec. 31	------	------	------	5	6	9.65	------
GRAND TOTAL				[illegible]	[illegible],125	2,264,375				$26,067,658
AVERAGE ANNUAL BENEFIT (27yrs.)										$ 965,469

*Based on weighted potential profit of $87.72 per acre

APPENDIX C

EXHIBIT 6

POTENTIAL AGRICULTURAL BEN
"RESERVOIR ONLY" PLAN

Year	Date of Flood Peak	Historic Stage (Hagansport)	Flood Duration	Acres Protected by New Works: Cleared	Acres Protected by New Works: Semi-Wooded	Acres Protected by New Works: Total Usable	Damage Prevented by New Works: % Lost Grazing	Damage Prevented by New Works: % of Stand	Damage Prevented by New Works: Production Loss/Acre*	Total Damages
1945	Feb. 28	42.1	Feb. 21-Mar. 4	6,250	1,000	7,250	4	0	$ 3.51	$ 25,448
	Mar. 31	45.1	Mar. 29-Apr. 3	7,400	1,200	8,600	6	2	7.02	60,372
	June 13	42.6	June 12-June 17	6,400	1,000	7,400	7	10	14.91	110,334
	Oct. 10	41.5	Oct. 9-Oct. 12	6,000	950	6,950	4	4	7.02	48,789
1946	June 2	41.4	May 15-June 4	5,950	900	6,850	17	16	28.95	198,308
	Nov. 6	45.1	Nov. 3-Nov. 11	7,400	1,200	8,600	5	0	4.39	37,754
1947	May 1	41.8	Apr. 30-May 4	6,100	950	7,050	8	6	12.28	86,574
1948	Jan. 2	42.2	Jan. 1-Jan. 5	6,000	1,000	7,000	2	0	1.75	12,250
	May 12	41.0	May 11-May 19	5,700	800	6,500	12	8	17.54	114,010
1949	Jan. 23	42.1	Jan. 25-Feb. 1	6,250	1,000	7,250	2	0	1.75	12,688
	Feb. 25	42.1	Feb. 24-Feb. 28	6,250	1,000	7,250	3	0	2.63	19,068
1950	Feb. 13	43.2	Feb. 2-Feb. 17	6,700	1,100	7,800	4	2	5.26	41,028
	May 3	41.4	May 1-May 17	5,950	900	6,850	15	11	22.81	156,249
	Sept 17	41.2	Sept 15-Sept 23	5,750	850	6,600	4	9	11.40	75,240
1951	June 13	42.2	June 4-June 19	6,000	1,000	7,000	12	13	21.93	153,510
1952	Apr. 23	43.4	Apr. 12-Apr. 27	5,750	1,100	6,850	12	7	16.67	114,190
	May 19	41.0	May 19-May 27	5,700	800	6,500	11	9	17.54	114,010
1953	Apr. 30	43.8	Apr. 29-May 19	6,800	1,150	7,950	17	14	27.19	216,161
1954	May 13	42.6	May 10-May 15	6,400	1,000	7,400	9	7	14.04	103,896
	Oct. 25	41.0	Oct. 23-Nov. 5	5,650	850	6,500	7	4	9.65	62,725
1955	Mar. 21	41.0	Mar. 21-Mar. 24	5,750	850	6,600	4	1	4.39	28,974
	Apr. 13	41.0	Apr. 13-Apr. 15	5,650	850	6,500	6	3	7.89	51,285
1956	Feb. 18	41.8	Feb. 17-Feb. 20	6,100	900	7,000	2	0	1.75	12,250
	May 2	41.7	May 2-May 5	6,050	900	6,950	8	6	12.28	85,346
1957	Apr. 27	43.4	Mar. 18-June 12	6,700	1,100	7,800	47	30	67.54	526,812
1958	Feb. 21	41.3	Feb. 14-Feb. 24	5,850	850	6,700	4	0	3.51	23,517
	Mar. 7	41.3	Mar. 4-Mar. 14	5,850	850	6,700	5	1	5.26	35,242
	May 3	45.5	Apr. 26-May 9	7,250	1,250	8,500	13	8	18.42	156,570
1959	Feb. 15	41.6	Feb. 14-Feb. 16	6,000	900	6,900	2	0	1.75	12,075
	Apr. 18	41.0	Apr. 17-Apr. 19	5,650	850	6,500	7	4	9.65	62,725
	June 24	42.5	June 21-June 27	6,400	1,000	7,400	6	10	14.04	103,896
	July 27	42.0	July 24-July 30	6,200	950	7,150	3	10	11.40	81,510
	Oct. 6	41.1	Oct. 5-Oct. 8	5,750	850	6,600	3	5	7.02	46,332
	Nov. 5	41.7	Nov. 4-Nov. 6	6,050	900	6,950	3	1	3.51	24,395
	Dec. 17	43.7	Dec. 15-Dec. 22	6,850	1,100	7,950	1	0	0.88	6,996
1960	Jan. 7	42.8	Jan. 1-Jan. 19	6,500	1,050	7,550	3	0	2.63	19,857
	Feb. 5	41.8	Feb. 3-Feb. 7	6,100	900	7,000	2	0	1.75	12,250
	Mar. 26	41.1	Mar. 25-Mar. 27	5,750	850	6,600	3	1	3.51	23,166
	June 13	41.5	June 12-June 15	5,900	900	6,800	7	10	14.91	101,388
	July 6	42.3	July 4-July 7	6,300	1,000	7,300	4	10	12.28	89,644
	Sept 27	42.4	Sept 6-Sept 29	6,350	1,000	7,350	3	7	8.77	64,460
	Oct. 6	42.4	Oct. 5-Oct. 8	6,350	1,000	7,350	4	6	8.77	64,460
	Oct. 29	42.0	Oct. 28-Oct. 30	6,200	950	7,150	5	2	6.14	43,901
	Dec. 8	44.1	Dec. 4-Dec. 15	6,900	1,150	8,050	3	0	2.63	21,172
1961	Feb. 7	42.0	Feb. 7-Feb. 25	6,200	950	7,150	5	7	10.53	75,290
	Mar. 30	43.4	Mar. 27-Apr. 5	6,700	1,100	7,800	7	2	7.89	61,542
	Nov. 23	42.2	Nov. 23-Nov. 27	6,250	1,000	7,250	5	0	4.39	31,828
	Dec. 10	42.4	Dec. 10-Dec. 21	6,350	1,000	7,350	2	0	1.75	12,863

Year	Date Flo... Pea...
1962	Jan.
	Feb.
	Mar.
	May
	June
	Sept
	Nov.
1963	Jan.
	Mar.
	Apr.
1964	Mar.
	Apr.
	May
	June
	Sept
	Nov.
1965	Feb.
	May
1966	Feb.
	May
	May
	Oct.
1967	June
	July
	Oct.
	Dec.
1968	Jan.
	Mar.
	June
	July
	Sept
	Nov.
	Dec.
1969	Jan.
	May
	Oct.
	Dec.
	Dec.
1970	Mar.
	Apr.
	Oct.
	Nov.
1971	Feb.
	Aug.
	Oct.
	Dec.
GRAND TOTAL	
AVERAGE AN...	

*Based on ...

by New Works Production Loss/Acre*	Total Damages
$ 3.51	$ 25,448
7.02	60,372
14.91	110,334
7.02	48,789
28.95	198,308
4.39	37,754
12.28	86,574
1.75	12,250
17.54	114,010
1.75	12,688
2.63	19,068
5.26	41,028
22.81	156,249
11.40	75,240
21.93	153,510
16.67	114,190
17.54	114,010
27.19	216,161
14.04	103,896
9.65	62,725
4.39	28,974
7.89	51,285
1.75	12,250
12.28	85,346
67.54	526,812
3.51	23,517
5.26	35,242
18.42	156,570
1.75	12,075
9.65	62,725
14.04	103,896
11.40	81,510
7.02	46,332
3.51	24,195
0.88	6,996
2.63	19,857
1.75	12,250
3.51	23,166
14.91	101,388
12.28	89,644
8.77	64,460
8.77	64,460
6.14	43,901
2.63	21,172
10.53	75,290
7.89	61,542
4.39	31,828
1.75	12,863

EXHIBIT 6

POTENTIAL AGRICULTURAL BENEFITS
"RESERVOIR ONLY" PLAN

				Acres Protected by New Works			Damage Prevented by New Works			
Year	Date of Flood Peak	Historic Stage (Hagansport)	Flood Duration	Cleared	Semi-Wooded	Total Usable	% Lost Grazing	% of Stand	Production Loss/Acre*	Total Damages
1962	Jan. 27	42.9	Jan. 26-Jan. 30	6,550	1,050	7,600	1	0	0.88	6,688
	Feb. 24	41.6	Feb. 24-Mar. 1	6,000	900	6,900	3	0	2.63	18,147
	Mar. 31	42.4	Mar. 31-Apr. 3	6,350	1,000	7,350	6	3	7.89	57,992
	May 1	42.6	Apr. 27-May 4	6,400	1,000	7,400	16	8	21.05	155,770
	June 30	42.8	June 28-July 3	6,500	1,050	7,550	6	10	14.04	106,002
	Sept 3	41.8	Sept 2-Sept 13	6,100	900	7,000	4	11	13.16	92,120
	Nov. 28	43.9	Nov. 22-Dec. 7	6,850	1,100	7,950	4	1	4.39	34,901
1963	Jan. 5	42.7	Jan. 5-Jan. 9	6,500	1,050	7,550	1	0	0.88	6,644
	Mar. 12	41.7	Mar. 12-Mar. 19	6,050	900	6,950	3	0	2.63	18,279
	Apr. 29	42.4	Apr. 28-May 2	6,350	1,000	7,350	7	5	10.53	77,396
1964	Mar. 10	42.8	Mar. 10-Mar. 12	6,500	1,050	7,550	3	1	3.51	26,501
	Apr. 24	43.2	Apr. 22-Apr. 30	6,650	1,100	7,750	10	4	12.28	95,170
	May 9	41.9	May 9-May 11	6,150	950	7,100	6	6	10.53	74,763
	June 2	44.0	May 31-June 21	6,900	1,100	8,000	15	16	27.19	217,520
	Sept 22	41.7	Sept 22-Sept 26	6,050	900	6,950	3	8	9.65	67,068
	Nov. 20	43.9	Nov. 19-Nov. 23	6,850	1,100	7,950	3	0	2.63	20,909
1965	Feb. 10	46.6	Jan. 9-Feb. 28	7,650	1,350	9,000	8	8	14.04	126,360
	May 11	45.8	May 11-June 1	7,400	1,250	8,650	14	18	28.07	242,806
1966	Feb. 10	44.3	Feb. 10-Feb. 13	7,000	1,150	8,150	1	0	0.88	7,172
	May 1	48.9	Apr. 23-May 6	--	--	--	14	6	17.54	---
	May 24	43.7	May 24-May 26	6,850	1,100	7,950	7	9	14.04	111,618
	Oct. 5	43.3	Oct. 5-Oct. 7	6,650	1,100	7,750	3	5	7.02	54,405
1967	June 2	45.7	Apr. 11-June 5	7,350	1,250	8,600	35	24	51.75	445,050
	July 7	42.4	July 5-July 7	6,350	1,000	7,350	4	10	12.28	90,258
	Oct. 30	45.4	Oct. 17-Nov. 5	7,250	1,250	8,500	7	7	12.28	104,380
	Dec. 15	44.6	Dec. 15-Dec. 24	7,050	1,150	8,200	2	0	1.75	14,350
1968	Jan. 31	43.7	Jan. 23-Feb. 3	6,850	1,100	7,950	2	0	1.75	13,913
	Mar. 21	46.0	Mar. 9-May 3	7,400	1,250	8,650	27	17	38.60	333,890
	June 12	45.6	June 12-June 30	7,350	1,250	8,600	12	13	21.93	188,598
	July 30	44.0	July 24-Aug. 3	6,900	1,100	8,000	4	10	12.28	98,240
	Sept 18	44.4	Sept 10-Sept 21	7,000	1,150	8,150	4	10	12.28	100,082
	Nov. 28	45.1	Nov. 27-Dec. 6	7,150	1,150	8,300	4	0	3.51	29,133
	Dec. 22	45.2	Dec. 22-Dec. 30	7,200	1,200	8,400	2	8	8.77	73,668
1969	Jan. 31	46.7	Jan. 30-Mar. 19	7,650	1,350	9,000	21	14	30.70	276,300
	May 9	46.3	May 6-May 31	7,550	1,300	8,850	4	1	4.39	38,852
	Oct. 31	41.1	Oct. 31-Nov. 3	5,750	850	6,600	2	0	1.75	11,550
	Dec. 8	42.1	Dec. 6-Dec. 11	6,250	950	7,200	1	0	0.88	6,336
	Dec. 29	46.0	Dec. 29-Jan. 4	7,400	1,300	8,700	1	0	0.88	7,656
1970	Mar. 1	46.1	Feb. 2-Mar. 28	7,450	1,300	8,750	15	10	21.93	191,888
	Apr. 26	46.8	Apr. 18-May 6	7,700	1,350	9,050	15	10	21.93	198,467
	Oct. 14	45.6	Oct. 12-Oct. 28	7,350	1,250	8,600	8	6	12.28	105,608
	Nov. 14	44.6	Nov. 14-Nov. 18	7,050	1,150	8,200	3	3	5.26	43,132
1971	Feb. 22	41.2	Feb. 22-Feb. 24	5,750	850	6,600	3	0	2.63	17,358
	Aug. 15	45.5	Aug. 15-Aug. 18	7,250	1,250	8,500	1	10	9.65	82,025
	Oct. 21	47.0	Oct. 4-Oct. 31	7,750	1,400	9,150	11	13	21.05	192,608
	Dec. 11	50.6	Dec. 3-Dec. 31	--	--	--	5	6	9.65	---
GRAND TOTAL				599,400	95,950	695,350				$7,923,910
AVERAGE ANNUAL BENEFIT (27 yrs.)										$ 293,478

*Based on weighted potential profit of $87.72 per acre

APPENDIX C

EXHIBIT 7

POTENTIAL AGRICULTURAL DAMAGES "RESERVOIR AND LEVEES" PLAN

Year	Date of Flood Peak	Historic Stage (Hagansport)	Flood Duration	Acres Protected by New Works: Cleared	Semi-Wooded	Total Usable	Damage Prevented by New Works: % Lost Grazing	% of Stand	Production Loss/Acre*	Total Damages
1945	Feb. 28	42.1	Feb. 21-Mar. 4	6,500	1,750	8,250	4	0	$ 3.51	$ 28,958
	Mar. 31	45.1	Mar. 29-Apr. 3	7,900	2,050	9,950	6	2	7.02	69,849
	June 13	42.6	June 12-June 17	6,775	1,800	8,575	7	10	14.91	127,853
	Oct. 10	41.5	Oct. 9-Oct. 12	6,300	1,625	7,925	4	4	7.02	55,634
1946	June 2	41.4	May 15-June 4	6,250	1,600	7,850	17	16	28.95	227,258
	Nov. 6	45.1	Nov. 3-Nov. 11	7,900	2,100	10,000	5	0	4.39	43,900
1947	May 1	41.8	Apr. 30-May 4	6,400	1,700	8,100	8	6	12.28	99,468
1948	Jan. 2	42.2	Jan. 1-Jan. 5	6,500	1,750	8,250	2	0	1.75	14,438
	May 12	41.0	May 11-May 19	6,000	1,500	7,500	12	8	17.54	131,550
1949	Jan. 23	42.1	Jan. 25-Feb. 1	6,025	1,725	7,750	2	0	1.75	13,563
	Feb. 25	42.1	Feb. 24-Feb. 28	6,025	1,725	7,750	3	0	2.63	20,383
1950	Feb. 13	43.2	Feb. 2-Feb. 17	6,900	1,900	8,800	4	2	5.26	46,288
	May 3	41.4	May 1-May 17	6,250	1,600	7,850	15	11	22.81	179,059
	Sept 17	41.2	Sept 15-Sept 23	6,100	1,550	7,650	4	9	11.40	87,210
1951	June 13	42.2	June 4-June 19	6,500	1,750	8,250	12	13	21.93	180,923
1952	Apr. 23	43.4	Apr. 12-Apr. 27	7,000	1,950	8,950	12	7	16.67	149,197
	May 19	41.0	May 19-May 27	6,000	1,500	7,500	11	9	17.54	131,550
1953	Apr. 30	43.8	Apr. 29-May 19	7,200	2,000	9,200	17	14	27.19	250,148
1954	May 13	42.6	May 10-May 15	6,700	1,800	8,500	9	7	14.04	119,340
	Oct. 25	41.0	Oct. 23-Nov. 5	6,000	1,500	7,500	7	4	9.65	72,375
1955	Mar. 21	41.0	Mar. 21-Mar. 24	6,100	1,500	7,600	4	1	4.39	33,364
	Apr. 13	41.0	Apr. 13-Apr. 15	6,000	1,500	7,500	6	3	7.89	59,175
1956	Feb. 18	41.8	Feb. 17-Feb. 20	6,400	1,700	8,100	2	0	1.75	14,175
	May 2	41.7	May 2-May 5	6,350	1,675	8,025	8	6	12.28	98,547
1957	Apr. 27	43.4	Mar. 18-June 12	7,000	1,950	8,950	47	30	67.54	604,483
1958	Feb. 21	41.3	Feb. 14-Feb. 24	6,200	1,550	7,750	4	0	3.51	27,203
	Mar. 7	41.3	Mar. 4-Mar. 14	6,200	1,550	7,750	5	1	5.26	40,765
	May 3	45.5	Apr. 26-May 9	8,200	2,100	10,300	13	8	18.42	189,726
1959	Feb. 15	41.6	Feb. 14-Feb. 16	6,300	1,600	7,900	2	0	1.75	13,825
	Apr. 18	41.0	Apr. 17-Apr. 19	6,000	1,500	7,500	7	4	9.65	72,375
	June 24	42.5	June 21-June 27	6,700	1,800	8,500	6	10	14.04	119,340
	July 27	42.0	July 24-July 30	6,500	1,700	8,200	3	10	11.40	93,480
	Oct. 6	41.1	Oct. 5-Oct. 8	6,100	1,500	7,600	3	5	7.02	53,352
	Nov. 5	41.7	Nov. 4-Nov. 6	6,350	1,675	8,025	3	1	3.51	28,168
	Dec. 17	43.7	Dec. 15-Dec. 22	7,200	1,950	9,150	1	0	0.88	8,052
1960	Jan. 7	42.8	Jan. 1-Jan. 19	6,750	1,800	8,550	3	0	2.63	22,487
	Feb. 5	41.8	Feb. 3-Feb. 7	6,400	1,700	8,100	2	0	1.75	14,175
	Mar. 26	41.1	Mar. 25-Mar. 27	6,100	1,500	7,600	3	1	3.51	26,676
	June 13	41.5	June 12-June 15	6,300	1,625	7,925	7	10	14.91	118,162
	July 6	42.3	July 4-July 7	6,600	1,725	8,325	4	10	12.28	102,231
	Sept 27	42.4	Sept 6-Sept 29	6,700	1,725	8,425	3	7	8.77	73,887
	Oct. 6	42.4	Oct. 5-Oct. 8	6,700	1,725	8,425	4	6	8.77	73,887
	Oct. 29	42.0	Oct. 28-Oct. 30	6,500	1,700	8,200	5	2	6.14	50,348
	Dec. 8	44.1	Dec. 4-Dec. 15	6,300	2,000	8,300	3	0	2.63	21,829
1961	Feb. 7	42.0	Feb. 7-Feb. 25	6,500	1,700	8,200	5	7	10.53	86,346
	Mar. 30	43.4	Mar. 27-Apr. 5	7,000	1,900	8,900	7	2	7.89	70,221
	Nov. 23	42.2	Nov. 23-Nov. 27	6,600	1,725	8,325	5	0	4.39	36,547
	Dec. 10	42.4	Dec. 10-Dec. 21	6,700	1,725	8,425	2	0	1.75	14,744

Year	Date of Flood Peak	Sta... (Hag...
1962	Jan. 27	42.9
	Feb. 24	41.
	Mar. 31	42.
	May 1	42.
	June 30	42.
	Sept 3	41.
	Nov. 28	43.9
1963	Jan. 5	42.7
	Mar. 12	41.7
	Apr. 29	42.
1964	Mar. 10	42.
	Apr. 24	43.
	May 9	41.
	June 2	44.
	Sept 22	41.
	Nov. 20	43.
1965	Feb. 10	46.
	May 11	45.
1966	Feb. 10	44.
	May 1	48.
	May 24	43.
	Oct. 5	43.
1967	June 2	45.
	July 7	42.
	Oct. 30	45.
	Dec. 15	44.
1968	Jan. 31	43.
	Mar. 21	46.
	June 12	45.
	July 30	44.
	Sept 18	44.
	Nov. 28	45.
	Dec. 22	45.
1969	Jan. 31	46.
	May 9	46.
	Oct. 31	41.
	Dec. 8	42
	Dec. 29	46
1970	Mar. 1	46.
	Apr. 26	46.
	Oct. 14	45
	Nov. 14	44
1971	Feb. 22	41
	Aug. 15	45
	Oct. 21	47
	Dec. 11	50

GRAND TOTAL

AVERAGE ANNUAL BENEF...

*Based on weighted a...

by New Works Production Loss/Acre*	Total Damages
$ 3.51	$ 28,958
7.02	69,849
14.91	127,853
7.02	55,634
28.95	227,258
4.39	43,900
12.28	99,468
1.75	14,438
17.54	131,550
1.75	13,563
2.63	20,383
5.26	46,288
22.81	179,059
11.40	87,219
21.93	[illegible]
16.67	[illegible]
17.54	[illegible]
27.19	[illegible]
14.04	[illegible]
9.65	[illegible]
4.39	[illegible]
7.89	[illegible]
1.75	[illegible]
12.28	[illegible]
67.54	[illegible]
3.51	[illegible]
5.26	[illegible]
18.42	[illegible]
1.75	13,825
9.65	[illegible]
14.04	[illegible]
11.40	93,480
7.02	[illegible]
3.51	28,168
0.88	[illegible]
2.63	22,487
1.75	14,175
3.51	26,676
14.91	118,162
12.28	102,231
8.77	73,887
8.77	73,887
6.14	50,348
2.63	21,829
10.53	86,346
7.89	70,221
4.39	36,547
1.75	14,744

EXHIBIT 7

POTENTIAL AGRICULTURAL DAMAGES
"RESERVOIR AND LEVEES" PLAN

Year	Date of Flood Peak	Stage (Hagansport)	Flood Duration	Acres Protected by New Works: Cleared	Semi-Wooded	Total Usable	Damage Prevented by New Works: % Lost Grazing	% of Stand	Production Loss/Acre*	Total Damages
1962	Jan. 27	42.9	Jan. 26-Jan. 30	6,800	1,850	8,650	1	0	0.88	7,612
	Feb. 24	41.6	Feb. 24-Mar. 1	6,300	1,650	7,950	3	0	2.63	20,929
	Mar. 31	42.4	Mar. 31-Apr. 3	6,700	1,725	8,425	6	3	7.89	66,473
	May 1	42.6	Apr. 27-May 4	6,700	1,800	8,500	16	8	21.05	178,925
	June 30	42.8	June 28-July 3	6,725	1,800	8,525	6	10	14.04	119,691
	Sept 3	41.8	Sept 2-Sept 13	6,400	1,700	8,100	4	11	13.16	106,596
	Nov. 28	43.9	Nov. 22-Dec. 7	7,250	2,000	9,250	4	1	4.39	40,608
1963	Jan. 5	42.7	Jan. 5-Jan. 9	6,700	1,800	8,500	1	0	0.88	7,480
	Mar. 12	41.7	Mar. 12-Mar. 19	6,350	1,675	8,025	3	0	2.63	21,106
	Apr. 29	42.4	Apr. 28-May 2	6,700	1,725	8,425	7	5	10.53	88,715
1964	Mar. 10	42.8	Mar. 10-Mar. 12	6,725	1,800	8,525	3	1	3.51	29,923
	Apr. 24	43.2	Apr. 22-Apr. 30	6,900	1,900	8,800	10	4	12.28	108,064
	May 9	41.9	May 9-May 11	6,450	1,700	8,150	6	6	10.53	85,820
	June 2	44.0	May 31-June 21	7,250	2,000	9,250	15	16	27.19	251,509
	Sept 22	41.7	Sept 22-Sept 26	6,350	1,675	8,025	3	8	9.65	77,441
	Nov. 20	43.9	Nov. 19-Nov. 23	7,250	2,000	9,250	3	0	2.63	24,328
1965	Feb. 10	46.6	Jan. 9-Feb. 28	8,650	2,200	10,850	8	8	14.04	152,334
	May 11	45.8	May 11-June 1	8,250	2,100	10,350	14	18	28.07	290,525
1966	Feb. 10	44.3	Feb. 10-Feb. 13	7,500	2,000	9,500	1	0	0.88	8,361
	May 1	48.9	Apr. 23-May 6	0	0	0	14	6	17.54	0
	May 24	43.7	May 24-May 26	7,025	1,950	8,975	7	9	14.04	126,009
	Oct. 5	43.3	Oct. 5-Oct. 7	6,900	1,900	8,800	3	5	7.02	61,776
1967	June 2	45.7	Apr. 11-June 5	8,250	2,200	10,450	35	24	51.75	540,788
	July 7	42.4	July 5-July 7	6,700	1,775	8,475	4	10	12.28	104,073
	Oct. 30	45.4	Oct. 17-Nov. 5	7,000	1,900	8,900	7	7	12.28	109,292
	Dec. 15	44.6	Dec. 15-Dec. 24	7,700	2,050	9,750	2	0	1.75	17,063
1968	Jan. 31	43.7	Jan. 23-Feb. 3	7,025	1,950	8,975	2	0	1.75	15,706
	Mar. 21	46.0	Mar. 9-May 3	9,350	2,200	11,550	27	17	38.60	445,830
	June 12	45.6	June 12-June 30	7,200	2,100	9,300	12	13	21.93	203,944
	July 30	44.0	July 24-Aug. 3	7,250	2,000	9,250	4	10	12.28	113,590
	Sept 18	44.4	Sept 10-Sept 21	7,500	2,025	9,525	4	10	12.28	116,967
	Nov. 28	45.1	Nov. 27-Dec. 6	7,800	2,100	9,900	4	0	3.51	34,749
	Dec. 22	45.2	Dec. 22-Dec. 30	7,750	2,100	9,850	2	8	8.77	86,385
1969	Jan. 31	46.7	Jan. 30-Mar. 19	8,700	2,200	10,900	21	14	30.70	334,630
	May 9	46.3	May 6-May 31	8,500	2,200	10,700	4	1	4.39	46,973
	Oct. 31	41.1	Oct. 31-Nov. 3	6,100	1,500	7,600	2	0	1.75	[illegible]
	Dec. 8	42.1	Dec. 6-Dec. 11	6,025	1,725	7,750	1	0	0.88	[illegible]
	Dec. 29	46.0	Dec. 29-Jan. 4	8,350	2,200	10,550	1	0	0.88	[illegible]
1970	Mar. 1	46.1	Feb. 2-Mar. 28	8,400	2,200	10,600	15	10	21.93	232,458
	Apr. 26	46.8	Apr. 18-May 6	8,750	2,200	10,950	15	10	21.93	240,134
	Oct. 14	45.6	Oct. 12-Oct. 28	8,200	2,200	10,400	8	6	12.28	127,712
	Nov. 14	44.6	Nov. 14-Nov. 18	7,750	2,100	9,850	3	3	5.26	51,811
1971	Feb. 22	41.2	Feb. 22-Feb. 24	6,100	1,550	7,650	3	0	2.63	20,120
	Aug. 15	45.5	Aug. 15-Aug. 18	8,100	2,200	10,300	1	10	9.65	90,305
	Oct. 21	47.0	Oct. 4-Oct. 31	8,750	2,200	10,950	11	13	21.05	230,498
	Dec. 11	50.6	Dec. 3-Dec. 31	0	0	0	5	6	9.65	0
GRAND TOTAL				637,075	168,525	805,600				$9,292,244
AVERAGE ANNUAL BENEFIT (27 yrs.)										$ 344,157

*Based on weighted average potential profit of $87.72 per acre

APPENDIX C

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EXHIBIT 8

NET PRODUCTIVE VALUE PER ACRE
"RESERVOIR ONLY" PLAN

Crop	Unit	Acres	Yield/ Acre	Total Yield	Price/ Unit	Gross Income	Prod. Cost: Per Acre	Total Prod. Cost	Net Return
Without Project									
Wooded	-	3,200	0	-	-	-	-	-	-
Native Pasture	Lbs	1,500	120	180,000	$0.462	$ 83,160	$20.80	$ 31,200	$ 51,960
Improved Pasture	Lbs	8,200	283	2,321,000	0.462	1,072,302	42.30	346,860	725,442
Hay	-	-	-	-	-	-	-	-	-
Total		12,900				$1,155,462		$378,060	$777,402
								(Rounded)	$777,000
With Project (Intensified Agricultural Use)									
Wooded		640	-	-	-	-	-	-	-
Native Pasture	Lbs	1,900	139	264,100	$0.462	$ 122,014	$25.60	$ 48,640	$ 73,374
Improved Pasture	Lbs	8,420	328	2,761,760	0.462	1,275,933	52.05	438,261	837,672
Hay	Ton	1,940	2.0	3,880	34.470	133,744	30.50	59,170	74,574
Total		12,900				$1,531,691		$546,071	$985,620
								(Rounded)	$986,000

EXHIBIT 9

NET PRODUCTIVE VALUE PER ACRE
"RESERVOIR AND LEVEES" PLAN

WITHOUT PROJECT

Crop	Unit	Acres	Yield/ Acre	Total Yield	Price/ Unit	Gross Income	Prod. Cost Per Acre	Total Prod. Cost	Net Return
Wooded	-	11,900	-	-	-	-	-	-	-
Native Pasture	Lbs.	3,300	120	396,000	$0.462	$ 182,952	$20.80	$ 68,640	$ 114,312
Improved Pasture	Lbs.	9,100	283	2,575,300	0.462	1,189,789	42.30	384,930	804,859
Hay	-		-	-	-	-	-	-	-
TOTAL		24,300				$1,372,741		$453,570	$ 919,171
								(Rounded)	$ 919,000

WITH PROJECT (INTENSIFIED AGRICULTURAL USE)

Crop	Unit	Acres	Yield/ Acre	Total Yield	Price/ Unit	Gross Income	Prod. Cost Per Acre	Total Prod. Cost	Net Return
Wooded		2,380	-	-	-	-	-	-	-
Native Pasture	Lbs.	5,820	139	808,980	$0.462	$ 373,749	$25.60	$148,992	$ 224,757
Improved Pasture	Lbs.	12,500	328	4,100,000	0.462	1,894,200	52.05	650,625	1,243,575
Hay	Ton	3,600	2.0	7,200	34.47	248,184	30.50	109,800	138,384
TOTAL		24,300				$2,516,133		$909,417	$1,606,716
								(Rounded)	$1,607,000

APPENDIX D

PLAN FORMULATION

APPENDIX D
PLAN FORMULATION

COOPER LAKE AND CHANNELS, TEXAS
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

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APPENDIX D

PLAN FORMULATION

SECTION I - FORMULATION PROCEDURES

The five deficiencies of the Cooper Lake and Channels final Environmental Impact Statement (EIS) as described in the Memorandum Opinion dated December 8, 1978, all relate either directly or indirectly to plan formulation and selection of the recommended plan. To supplement the final EIS in a manner that would bring it in full compliance with the National Environmental Policy Act and the Court Order requires a reexamination of alternatives previously formulated and considered, development of alternatives specifically required by the Court Order (water supply without flood control and comprehensive nonstructural flood plain management), and development of alternatives needed to adequately address any concerns that may have surfaced during the reexamination process. These alternatives would be screened down to a final array and ultimately a plan would be selected for recommendation. The process just described is documented in this appendix. Section II deals with reexamination of the without project condition (status quo) and 22 alternative plans presented in the final EIS. Data on these alternatives remain as in the final EIS except where changes have resulted from correcting Court-identified deficiencies and other minor discrepancies. Development of the alternatives required by the Court, water supply and nonstructural, are documented in Sections III and IV, respectively. Alternatives addressing concerns which surfaced during reexamination of the final EIS alternatives are developed in Section V. Section VI presents the alternatives selected for the new final array and describes these alternatives in detail. It also presents fish and wildlife compensation requirements for each of these alternatives, gives evaluations of the alternatives, and documents the selection of the supplemental EIS recommended plan. Through this point, all analyses and data are shown based on 1974 conditions of development, flood plain modifications, land use, and prices. This is to retain general comparability with data in the final EIS. In Section VII the supplemental EIS recommended plan is reevaluated based on 1980 conditions and prices.

SECTION II - ALTERNATIVES CONSIDERED IN THE FINAL EIS

General

Nineteen structural and three nonstructural alternatives were considered in the final EIS. These alternatives were formulated to fully or partially respond to the Congressionally authorized purposes of the Cooper Lake and Channels project. Status Quo was listed as the twenty-third alternative. It is actually the without project condition against which all alternative plans are evaluated.

The 23 alternatives considered in the final EIS were evaluated in a Plan Selection Report (General Design Memorandum No. 2-B, Revised, Supplement No. 1) approved 11 August 1977. That document provides information developed specifically for the final EIS along with additional design, economic, social, and environmental data required for plan formulation but not normally included in an EIS.

Without Project Condition (Status Quo)

The condition of the flood plain, including completed levee and channel systems, as it existed in 1974 was considered the without project condition. The term applied to this condition in the final EIS was "Status Quo." This condition was an alternative course of action as well as the basis for evaluating all other alternatives.

The completed levee and channel systems in the without project condition include old levees originally constructed by individual farmers or groups of farmers, larger levee systems constructed later with authorization from State legislation, and Federal systems completed subsequent to the 1955 authorization of Cooper Lake and Channels. Completed levee systems are shown with the final EIS recommended plan on Plate B. Many of these levees have fallen to various stages of ineffectiveness due in part to large floods exceeding design without the stage-lowering effect of Cooper Lake and lack of proper maintenance. With the exception of 1LS, existing levees which were still effective to varying degrees would become totally ineffective over time without additional flood control efforts in the watershed. The underlying assumption was that continued frequent floods exceeding levee designs without the lake would eventually cause farmers and levee districts to discontinue maintenance. This assumption is supported by the fact that some of the older and smaller levees have already been abandoned. The land use behind deteriorating levees was not expected to change.

The 30-year flood plain under the without project conditions involves over 90,000 acres of land. The following tabulation presents 30-year flood plain acreages as reported in the final EIS and Plan Selection Report for the project area along the South Sulphur and

Sulphur Rivers from the headwaters of Cooper Lake to U.S. 259 at the headwaters of Wright Patman Reservoir.

Usable Areas				Agriculturally Unusable *	Total
Wooded	Semiwooded	Cleared	Total		
58,000	12,300	18,900	89,200	2,000	91,200

* Includes areas in existing channels and levees.

Cleared and semiwooded lands were used predominately as pasture to support beef cattle production and dairy operations. Limited timber cutting was reported in wooded areas. Wooded areas were determined suitable for pasture if cleared and protected from floods. No land use or land cover changes for the flood plain were projected under the without project (Status Quo) condition.

Based on 1974 prices and conditions, and 27 years of flood records, average annual agricultural flood damages were estimated to be $970,000. Average annual nonagricultural damages (fences, bridges, levees, etc.) were estimated to be $1,260,000 based on Corps of Engineers damage surveys on the floods of October to December 1971. Under without project conditions, inadequate municipal and industrial water supplies were projected for cities and urban areas served by the entities which have contracted for water storage in Cooper Lake. Although there is demand, recreation use in the area under without project conditions is low because of private ownership of lands and limited access to streams.

Structural Alternatives

Studies for various structural alternatives were made at both 15-year and 30-year design flood levels. Backwater analyses at these two flood levels indicated relatively minor difference in areas inundated. The channel capacity was shown to be exceeded by floods of very low frequency which spread very rapidly over the flood plain. Once the valley floor was covered with floodwaters, the conveyance of the flood plain would increase rapidly with a relatively small increase in stage. Thus, incremental flood control benefits between 15-year and 30-year levels of protection indicated the additional protection would be provided with nominal increases in costs. Therefore, even though incremental benefits were small, the nominal increases in costs and the fact that existing levees were designed to provide 30-year protection with the reservoir justified the determination to display and evaluate structural alternatives designed to the 30-year level in the final EIS.

a. <u>Fully Responsive</u>. Ten structural alternatives were evaluated in the final EIS which were considered fully responsive to the authorized project proposes of water supply, flood control, and recreation.

Water quality control was deleted as a project purpose due to policy changes regarding dilution of pollutants by releases from reservoir storage. These ten alternatives are briefly discussed below. They are covered in greater detail in the final EIS and the Plan Selection Report.

(1) Authorized Plan. This plan consists of a proposed multiple-purpose lake at river mile 23.2 of the South Sulphur River; a total of about 35 miles of channelization; and about 27 miles of strengthened, extended, or new levees. Protection to the 30-year level would be provided to 23,700 acres of flood plain lands. Of this area, 11,600 acres are wooded, 80 percent of which would be expected to be cleared for agricultural development which correspondingly would be destructive to fish and wildlife habitat. In addition to providing 131,400 acre-feet of flood control storage, the authorized lake would provide 273,000 acre-feet of municipal and industrial water supply storage with a dependable yield of 169 cfs (109 mgd). The lake and proposed recreation facilities would support about 741,000 general recreation visitors annually. The lake would provide an additional 178,000 annual visitor-days of fishing and waterfowl hunting. Direct and induced losses of fish and wildlife recreation as a result of the plan amount to about 12,000 man-days. Air, noise, and water pollution would be expected during construction of this plan, but the area is rural and sparsely populated so that social impacts would be minimized. At least 90 identified archeological and historical sites would be directly affected by the lake, and two additional sites may be affected by downstream work.

(2) Reservoir and Channel. This plan would combine the authorized lake feature with approximately 55 miles of flood control channel. No new levees would be included in this plan. In addition to the benefits of water supply and recreational potential to be derived from the lake (as previously described under the authorized plan), this plan would provide 30-year protection to 49,200 acres of flood plain lands. The design flood would be contained entirely within the banks of the channel. The protected area would include 28,000 acres of wooded lands of which 80 percent would be expected to be cleared for agricultural development. The results would, on the balance, be very destructive of fish and wildlife resources. The right-of-way area used for disposal of dredged material from channel construction would, however, provide considerable habitat for various wildlife species during the successional process. Although considerable air and noise pollution could be expected during construction, the area is sparsely inhabited, thus the adverse social impacts would be minimized. In addition to those archeological sites affected by the lake impoundment, downstream channelization could impact upon one site near Talco, Texas. No other known cultural resources would be affected.

(3) Reservoir and Levees. This plan would combine the authorized lake with approximately 27 miles of enlarged, extended, or newly constructed levees, and 7 miles of channelization. This plan provides the same water supply and recreational benefits described for the authorized

lake and a similar amount of flood protection (24,300 acres protected to the 30-year level of which 11,900 acres are wooded). Much less destruction of the natural river would, however, occur. In addition to those archeological sites affected by the impoundment, one of the new levees could affect one site. No other known cultural resources would be affected.

(4) Reservoir, Levees, and Channel with Landside Levee Borrow. This plan follows the specifications of the authorized plan except that the levee borrow material is taken from the landside of the levees instead of the flood side. The right-of-way required would be greater for this project than the authorized plan since additional lands must be acquired as borrow area. Accordingly, somewhat larger lands must be acquired as borrow area. Accordingly, somewhat larger wildlife habitat losses would be expected. Impacts on archeological resources are identical to the authorized plan.

(5) Reservoir and Levee Alignment with Channel Adjacent to the Levees. The lake and levee alignment of this plan follow the specification of the authorized plan. Unlike the authorized plan, however, the channel runs adjacent to the levees. Although the length of the channel in this alignment is the same as in the authorized plan, the alignment in this alternative more closely follows the natural Sulphur River and, accordingly, fewer oxbow lakes would be formed. Other than this, the impacts are similar to the authorized plan.

(6) Reservoir and Channel Alignment with Levees Adjacent to the Channel. The lake and channel alignment of this plan follow the specifications of the authorized plan. Unlike the authorized plan, however, the levees would be constructed adjacent to the channel. Higher levees would be required due to the reduced floodway width. Approximately 26,200 acres would be protected to the 30-year level with this plan, 14,100 of which is wooded. Since 80 percent of this wooded area would likely be cleared for agricultural purposes, wildlife resource losses would be greater for this plan than for the authorized plan. The new levee alignment in this plan would not disturb any known cultural resource.

(7) Reservoir and Levee Alignment with Clearing and Snagging of the River. This plan consists essentially of the same lake and the same levee and channel alignments as presented in the Reservoir and Levees plan. Additionally, it includes the clearing and snagging of the existing river. The increase in channel capacity due to this clearing and snagging would be only a small percentage of the total natural channel capacity and therefore, during major flood flows the clearing and snagging work in and of itself would not yield significant incremental benefits. The plan would provide 30-year protection to 24,100 acres, 11,800 acres of which are wooded. Generally, the adverse impacts of this plan would be similar to those associated with the Reservoirs and Levees plan. However, the additional loss of terrestrial habitat to the clearing and snagging features would increase wildlife and fishery resource losses. In addition to the

archeological sites referred to in the Reservoir and Levee plan, clearing and snagging would affect two documented sites.

(8) Reservoir and Levee Alignment with Clearing and Snagging Plus Selected Major Bend Cutoffs. In this plan, the lake and the levee alignment of the authorized plan were combined with clearing and snagging of the existing river and excavation of cutoffs at selected major bends of the river, in lieu of a complete channel excavation. Excavation of these cutoffs would be effective, at least temporarily, in reducing water levels not only through the cutoff section, but also slightly upstream and downstream of the cutoffs. This plan would provide 30-year flood protection to 23,900 acres, 11,700 acres of which are wooded. Losses in fish and wildlife resources would be slightly greater than in the plan, Reservoir and Levee Alignment with Clearing and Snagging of the River, due to the additional channelization. However, no additional adverse impacts to archeological sites should result from the major bend cutoffs.

(9) Reservoir and Levee Alignment with Selected Major Bend Cutoffs. This plan is similar to the Reservoir and Levee Alignment with Clearing and Snagging Plus Major Bend Cutoffs alternative, except that clearing and snagging of the existing river are not required. This plan would provide 30-year flood protection to 24,000 acres. Of this, 11,800 acres are wooded. Wildlife and fishery resource losses would be slightly less than with the Reservoir and Levee Alignment with Clearing and Snagging Plus Major Bend Cutoffs alternative, since the clearing and snagging have been excluded. Adverse effects to archeological resources would be the same as those presented in the Reservoir and Levees alternative, since the major bend cutoffs would not affect any known cultural resources.

(10) Reservoir, Levees, and Channel with Channel Bottom Raised 5 Feet. This plan is identical to the authorized plan, except that the channel bottoms are excavated 5 feet less in depth. Generally, the beneficial impacts are identical to those of the authorized plan. Only a slight variation in wildlife resource losses could be expected between this alternative and the authorized plan. Effects on cultural resources are identical to the authorized project.

(11) Analysis. Table 1 provides economic data on the ten fully responsive alternatives shown in the final EIS. These data were extracted from the final EIS, Plan Selection Report, and supporting documents. Table 2 provides readily quantifiable environmental data on the fully responsive alternatives which were also extracted from the final EIS, Plan Selection Report, and supporting documents.

The data in table 1 indicate economic differences among the ten alternatives which, with the possible exception of the Reservoir and Channel alternative, are basically insignificant when considering the magnitude of the numbers and the accepted level of accuracy of these estimates. All alternatives are shown to be justified with benefit-cost ratios of 1.4 or 1.5. On the basis of net benefits, the Reservoir and Channel alternative would be favored from an economic standpoint, even though its benefit-cost ratio is slightly lower than the others.

TABLE 1

ECONOMIC COMPARISON OF FULLY RESPONSIVE ALTERNATIVES
(From Final EIS, Plan Selection Report, and Supporting Documents)

($1,000)

Alternative	Costs		Average Annual Benefits						Benefit Cost Ratio	Net Benefits
	First Cost	Average Annual Charges	Flood Control	Recreation	Fish & Wildlife	Water Supply	Employ-ment	Totals		
1. Authorized Plan	68,737	3,236.4	1,253.0	1,111.5	355.5	1,728.0	258.9	4,706.9	1.5	1,470.5
2. Reservoir & Channel	99,124	4,372.5	2,621.0	1,111.5	351.5	1,728.0	380.3	6,192.3	1.4	1,819.8
3. Reservoir & Levees (FEIS Recommended Plan)	67,764	3,178.1	1,292.0	1,111.5	341.0	1,728.0	255.0	4,727.5	1.5	1,549.4
4. Reservoir, Levees, and Channel with Landside Levee Borrow	68,825	3,243.0	1,253.0	1,111.5	355.5	1,728.0	259.0	4,707.0	1.5	1,464.0
5. Reservoir & Channel Alignment w/ Channel Ad-jacent to the Levees	68,737	3,235.4	1,274.0	1,111.5	349.8	1,728.0	258.9	4,722.2	1.5	1,486.8
6. Reservoir & Channel Alignment w/ Levees Adjacent to the Channel	70,449	3,298.4	1,397.0	1,111.5	355.5	1,728.0	266.2	4,858.2	1.5	1,559.8
7. Reservoir & Levee Align-ment with Clearing & Snagging of the River	68,472	3,227.4	1,288.0	1,111.5	341.0	1,728.0	257.7	4,726.2	1.5	1,498.8

TABLE 1 (continued)

($1,000)

Alternative	Costs: First Cost	Costs: Average Annual Charges	Average Annual Benefits: Flood Control	Average Annual Benefits: Recreation	Average Annual Benefits: Fish & Wildlife	Average Annual Benefits: Water Supply	Average Annual Benefits: Employment	Average Annual Benefits: Totals	Benefit Cost Ratio	Net Benefits
8. Reservoir & Levee Alignment with Clearing & Snagging Plus Major Bend Cutoffs	68,533	3,229.6	1,270.0	1,111.5	345.8	1,728.0	258.3	4,713.6	1.5	1,484.0
9. Reservoir & Levee Alignment with Selected Major Bend Cutoffs	67,944	3,202.4	1,317.0	1,111.5	345.8	1,728.0	256.5	4,758.8	1.5	1,556.4
10. Reservoir, Levees & Channels with Channel Bottom Raised 5 Feet	68,017	3,211.6	1,262.0	1,111.5	355.5	1,728.0	255.9	4,712.9	1.5	1,501.3

TABLE 2

ENVIRONMENTAL COMPARISON OF FULLY RESPONSIVE ALTERNATIVES
(From Final EIS, Plan Selection Report, and Supporting Documents)

Alternatives	Environmental Losses				Environmental Benefits		
	Terrestrial Habitat (Acres)	Aquatic Habitat (Acres)	Recreational Potential (Man-Days)	Fish and Wildlife ($)	Aquatic Habitat (Acres)	Recreational Potential (Man-Days)	Fish and Wildlife ($)
1. Authorized Plan (Draft EIS Plan)	37,705	575	29,836	71,384	19,353	931,052	355,465
2. Reservoir and Channel	63,325	614	49,526	125,481	19,283	928,724	351,525
3. Reservoir and Levees (FEIS Recommended Plan)	37,345	138	20,779	54,102	19,096	922,507	341,010
4. Reservoir, Levees, and Channel with Landside Levee Borrow	38,045	575	30,064	72,014	19,353	931,052	355,465
5. Reservoir and Levee Alignment with Channel Adjacent to the Levees	37,705	575	29,836	71,384	19,252	927,693	349,779
6. Reservoir and Channel Alignment with Levees Adjacent to the Channel	39,705	575	31,600	76,356	19,353	931,052	355,465
7. Reservoir and Levee Alignment with Clearing and Snagging of the River	38,865	138	21,975	57,447	19,096	922,507	341,010
8. Reservoir and Levee Alignment with Clearing and Snagging Plus Major Bend Cutoffs	38,385	231	23,483	59,954	19,182	925,366	345,845
9. Reservoir and Levee Alignment with Selected Major Bend Cutoffs	37,365	231	22,729	57,859	19,182	925,366	345,845
10. Reservoir, Levees, and Channel Bottom Raised 5 Feet	37,785	575	29,906	71,581	19,353	931,052	355,465

However, table 2 shows that quantifiable environmental losses of the Reservoir and Channel alternative are significantly greater than those of the nine other alternatives. This is primarily due to the extensive channelization involved. In terms of absolute quantifiable terms, the Reservoir and Levees alternative would cause fewer environmental related losses than any of the others. It was considered the best of the fully responsive alternatives.

b. Partially Responsive. Nine structural alternatives were evaluated in the final EIS which were considered partially responsive to the authorized project purposes of flood control, water supply, and recreation. These nine alternatives are briefly discussed below. They are covered in more detail in the final EIS and the Plan Selection Report.

(1) Reservoir Only. The plan consists of a lake built to the same specification as the authorized impoundment. No additional downstream improvements would be constructed with the exception of 4RSS spur which is required for proper reservoir operation. Reservoir storages, dependable yield, and recreation features are identical to those previously discussed under the reservoir features of the authorized plan. The plan is only partially responsive in that it would provide the authorized degree of flood protection to a much smaller portion of the total flood plain than would the authorized plan. Flood control in the reservoir would provide 30-year level of protection to 12,900 acres, 3,200 of which are wooded.

(2) Reservoir and Selective Floodproofing by Ring Levees. This plan combines the authorized lake with selective floodproofing of areas downstream from Cuthand Creek. Floodproofing would be accomplished by construction of seven ring levees at isolated areas where protection from serious flooding would be considered desirable. Protection to the 30-year level would be provided for 23,800 acres, 14,000 acres of which are wooded. Induced losses to terrestrial and aquatic habitats and recreational potential would be somewhat less than related to the authorized plan and, accordingly, the adverse impacts on wildlife and fishery resources would be somewhat less. No archeological sites, other than those inundated by the lake, would be affected by this alternative.

(3) Reservoir with Animal Refuge Mounds. Under this plan, the authorized lake is combined with animal refuge mounds located at 1-mile intervals along the flood plain to provide high ground to livestock within reasonable distance of any point in the flood plain below the dam. The features of the lake facet of this alternative would be identical to those previously discussed under the authorized plan. Protection to the 30-year level would be provided for 13,000 acres, 3,200 of which are wooded. No additional significant benefits or losses to wildlife populations are expected from the refuge mounds. No further adverse effects to archeological or other cultural resources are expected from construction of the animal refuge mounds.

(4) Reservoir and Nonrestrictive Easement. A nonrestrictive flood damage easement combined with the lake features of the authorized plan

would allow local residents to continue living, farming, and developing their land within the flood plain of the Sulphur River as normally would be expected under existing conditions and trends. Approximately 50 percent of the cost of the land would be paid to individual landowners and they, in turn, would absorb any flood related damages. This alternative would not provide any additional flood prevention benefits beyond those attributed to the 12,900 acres protected by the impoundment itself. Environmental benefits and damages would be the same as those discussed under the reservoir feature of the authorized plan.

(5) Reservoir and Restrictive Easement. Restrictive flood easement acquisition combined with the authorized lake would involve the purchase and removal of all flood damageable property within the Sulphur River flood plain, downstream from the dam, and restriction of future use and development of the area including some agricultural developments. The reservoir would provide 30-year protection to 12,900 acres. People presently living within the flood plain area would be required to move, although they would still own the land. Since this alternative would restrict future use and development of the basin, it would preserve the status quo downstream of the damsite and would eliminate further damage to downstream wildlife and fishery populations. Only the archeological resources within the lake area would be affected.

(6) Reservoir and Fee Purchase. This plan involves a combination of the authorized lake with fee acquisition of the downstream flood plain, in lieu of an easement. The reservoir would provide 30-year protection to 12,900 acres. The acquired lands would be fallow, reverting to a wild state, and open to the public for hunting or other recreational use. This alternative, however, will not fulfill the social and economic requirements of present and future generations living in the lower Sulphur River Basin and contiguous areas.

(7) Channel Only. This alternative involves the excavation of approximately 60 miles of new channel along the South Sulphur and Sulphur Rivers. The benefits of water supply and recreation which accompany the authorized lake feature would be absent in this plan. This plan provides 30-year protection to 61,800 acres, of which 34,000 are wooded. The plan would promote a greater amount of induced clearing than any of the other alternatives. Construction of this channel could affect a total of 13 archeological sites.

(8) Levees Only. This plan involves the enlargement, extension, or new construction of some 50 miles of levees. Some channel excavation and realignment is required under this plan since the best flood design location of levees necessitates cutting off some natural channel bends. As with the channel only plan, the benefits of water supply and recreation which would attend the authorized plan would be absent in this alternative. Protection of the 30-year level would be provided to 28,700 acres, 12,200 of which are wooded. This plan would require the least amount of acreage for construction. No archeological sites would be affected by raising existing levees in the vicinity of the Cooper Lake site. Downstream of the authorized damsite, one large archeological site could be affected.

(9) <u>Channel and Levees</u>. This plan requires the construction of 50 miles of channel. The levee design and construction required in this plan is the same as for the Levees Only alternative. The water supply and recreation benefits which attend any of the alternatives with a reservoir would be foregone in this plan. Protection of the 30-year level would be provided to 27,900 acres, 11,900 of which are wooded. A total of 13 archeological sites would be affected either by direct excavation of the channel or by dredged material deposition.

(10) <u>Analysis</u>. Table 3 provides economic data on the nine partially responsive alternatives shown in the final EIS. These data were extracted from the final EIS, Plan Selection Report, and supporting documents. Table 4 provides readily quantifiable environmental data on the fully responsive alternatives which were also extracted from the final EIS, Plan Selection Report, and supporting documents.

The data in Table 3 show more variance in benefit-cost ratios and net benefits for the partially responsive alternatives than table 1 showed for the fully responsive alternatives. Even with $728,000 average annual flood control benefits added to the Reservoir and Nonrestrictive Easement, Reservoir and Restrictive Easement, and Reservoir and Fee Purchase alternatives (see Note 1, table 3) they remain less desirable from an economic standpoint. The Channel Only, Levees Only, and Channel and Levees alternatives appear the most desirable economically but they do nothing to address the critical water supply needs and the demand for recreational opportunities in the area. Although the Reservoir with Animal Refuge Mounds alternative is justified with a 1.4 benefit-cost ratio and $1,175,100 net benefits, it is not incrementally justified over the Reservoir Only alternative. The Reservoir and Selective Floodproofing by Ring Levees alternative would be incrementally justified economically over the Reservoir Only alternative, but it would cause significantly greater environmental losses as shown in table 4. Also, Reservoir Only would protect only 3,200 acres of wooded land while Reservoir and Selective Floodproofing by Ring Levees would protect 14,000 wooded acres. It was assumed that 80 percent of protected wooded lands (mostly bottomland hardwoods) would be cleared.

Generally, the Reservoir Only alternative would cause as few or fewer environmental losses and as great or greater environmental benefits as any other partially responsive alternative. It addresses all three project purposes, although the area protected from 30-year level floods is less than under the authorized plan. It is economically justified with a 1.4 benefit-cost ratio and $1,188,800 net benefits. For these reasons, Reservoir Only was considered the best of the partially responsive alternatives.

Nonstructural Alternatives

The final EIS presents general descriptions and impacts of four categories of nonstructural flood damage reduction measures. These are flood plain regulation (zoning), flood plain acquisition, flood insurance, and flood warning and evacuation. Measures in the categories of flood plain

TABLE 3

ECONOMIC COMPARISON OF PARTIALLY RESPONSIVE ALTERNATIVES
(From Final EIS, Plan Selection Report, and Supporting Documents)

($1,000)

Alternative	Costs		Average Annual Benefits						Benefit Cost Ratio	Net Benefits
	First Cost	Average Annual Charges	Flood Control	Recreation	Fish and Wildlife	Water Supply	Employment	Totals		
1. Reservoir Only	64,324	2,959.1	728.0	1,111.5	355.6	1,728.0	244.8	4,167.9	1.4	1,208.8
2. Reservoir & Selective Floodproofing by Ring Levees	67,282	3,160.1	1,338.0	1,111.5	343.1	1,728.0	253.3	4,773.9	1.5	1,613.8
3. Reservoir w/ Animal Refuge Mounds	64,429	2,963.1	727.0	1,111.5	335.6	1,728.0	236.1	4,138.2	1.4	1,175.1
4. Reservoir & Nonrestrictive Easement	71,692	3,458.1	0 1/	1,111.5	335.6	1,728.0	235.7	3,410.8	0.9	- 47.3
5. Reservoir & Restrictive Easement	75,768	3,696.1	0 1/	1,111.5	335.6	1,728.0	235.7	3,410.8	0.9	- 285.3
6. Reservoir & Fee Purchase	82,242	4,151.1	0 1/	1,111.5	433.0	1,728.0	235.7	3,508.2	0.8	- 642.9
7. Channel Only	45,890	1,840.0	3,018.0	0	15.9	0	189.2	3,223.1	1.8	1,383.1
8. Levees Only	5,678	311.3	1,449.0	0	5.4	0	45.8	1,500.2	4.8	1,188.9
9. Channel and Levees	6,611	366.3	1,388.0	0	19.9	0	45.3	1,453.2	4.0	1,086.9

1/ The reservoir considered with Reservoir and Nonrestrictive Easement, Reservoir and Restrictive Easement, and Reservoir and Fee Purchase will have the same flood control capacity as the Reservoir Only alternative. These plans assumed the fee purchase, restrictive easement, or non-restrictive easement of all land within the 30-year flood plain below the damsite. Therefore, no flood damages were credited to any of these plans.

TABLE 4

ENVIRONMENTAL COMPARISON OF PARTIALLY RESPONSIVE ALTERNATIVES
(From Final EIS, Plan Selection Report, and Supporting Documents)

Alternatives	Environmental Losses				Environmental Benefits		
	Terrestrial Habitat (Acres)	Aquatic Habitat (Acres)	Recreational Potential (Man-Days)	Fish and Wildlife ($)	Aquatic Habitat (Acres)	Recreational Potential (Man-Days)	Fish and Wildlife ($)
Reservoir Only	27,785	42	11,872	31,069	19,000	919,315	335,610
Reservoir and Selective Flood-proofing by Ring Levees	34,145	159	19,750	51,053	19,133	923,737	343,090
Reservoir with Animal Refuge Mounds	27,785	42	11,872	31,069	19,000	919,315	335,610
Reservoir and Nonrestrictive Easement	27,785	42	11,872	31,069	19,000	919,315	335,610
Reservoir and Restrictive Easement	27,785	42	11,872	31,069	19,000	919,315	335,610
Reservoir and Fee Purchase	27,785	42	11,872	31,069	19,000	962,500	433,003
Channel Only	51,800	636	48,864	124,008	283	9,409	15,915
Channel and Levees	16,720	573	22,303	51,347	353	11,737	19,855
Levees Only	16,260	96	12,357	32,313	96	3,192	5,400

regulation, flood insurance, and flood warning and evacuation were dismissed without quantification and detailed consideration of costs, benefits, and environmental impacts. Under the flood plain acquisition category, three measures were quantified and evaluated in the final EIS with the 19 structural alternatives. The three plans discussed below involved acquisition of 89,200 flood plain acres by fee purchase, restrictive easement, and nonrestrictive easement. They are covered in more detail in the final EIS and the Plan Selection Report.

a. Fee Purchase. This plan would eliminate the possibility of new development in the flood plain and would restore and maintain natural, scenic, and recreational qualities on the Sulphur River. Approximately 58,000 acres of bottomland hardwoods and 31,200 acres of agricultural lands would be purchased with existing activities removed. Recreational benefits would accrue from intense management and public use of these lands for big and small game hunting, waterfowl hunting, waterfowl-oriented recreation, and general recreation.

b. Restrictive Easement. Under this plan an easement would be taken on the 89,200 flood plain acres which would require purchase and removal of existing damageable properties and restrict future development in the flood plain. The possibility of further damage to wildlife and fishery populations would be eliminated. The landowners would be paid the capitalized values of the net difference in future income with and without the easement.

c. Nonrestrictive Easement. Under this plan an easement would be taken on the 89,200 flood plain acres which would not restrict future development but would pay the landowners capitalized values of anticipated future flood losses. Individual landowners would then absorb future damages to life, health, and property.

d. Analysis. Table 5 provides economic data on the three nonstructural plans evaluated in the final EIS. These data were extracted from the final EIS, Plan Selection Report, and supporting documents. Table 6 provides readily quantifiable environmental data which were also extracted from the final EIS, Plan Selection Report, and supporting documents. For many of the parameters evaluated in tables 5 and 6, the three nonstructural plans, as formulated, provide no significant change from the without project condition. In those cases, the benefits will be zero.

Final EIS Recommended Plan

From the 22 alternatives and the without project condition (status quo), the Reservoir and Levees plan was selected and displayed as the final EIS recommended plan. The features of this plan are shown in detail on Plate B. Features identified on this plate as completed or existing are part of the without project condition. The Reservoir and Levees plan consists of the multiple-purpose Cooper Lake; levee 4RSS spur; levee 4LSS extension; levee 3RS spur, strengthening, and extension; and a new levee 4RS channelization and floodway clearing would

TABLE 5

ECONOMIC COMPARISON OF NONSTRUCTURAL ALTERNATIVES
(From Final EIS, Plan Selection Report, and Supporting Documents)

($1,000)

Alternative	Costs		Average Annual Benefits						Benefit Cost Ratio	Net Benefits
	First Cost	Average Annual Charge	Flood Control	Recreation	Fish and Wildlife	Water Supply	Employ-ment	Totals		
1. Fee Purchase	26,985	1,782.5	0	370.1	122.1	0	0	492.2	0.3	- 1,289.8
2. Restrictive Easement	18,439	1,149.0	0	0	0	0	0	0	0	- 1,149.0
3. Nonrestrictive Easement	11,283	754.0	0	0	0	0	0	0	0	- 754.0

TABLE 6

ENVIRONMENTAL COMPARISON OF NONSTRUCTURAL ALTERNATIVES
(From Final EIS, Plan Selection Report, and Supporting Documents)

Alternatives	Environmental Losses				Environmental Benefits		
	Terrestrial Habitat (acres)	Aquatic Habitat (acres)	Recreational Potential (Man-days)	Fish and Wildlife ($)	Aquatic Habitat (acres)	Recreational Potential (Man-days)	Fish and Wildlife ($)
1. Fee Purchase	0	0	0	0	0	300,990	122,094
2. Restrictive Easement	0	0	0	0	0	0	0
3. Nonrestrictive Easement	0	0	0	0	0	0	0

be required in conjunction with levees 4LSS and 4RS. Pertinent data for these features of the Reservoir and Levees plan are shown in table 7.

Analysis

After reexamination of alternatives formulated and considered in the final EIS and supporting documents, the Reservoir and Levees plan and the Reservoir Only plan were selected for the final array of alternatives to be evaluated in the supplemental EIS. These two plans were shown to be the most desirable, respectively, of the fully responsive and partially responsive plans in the final EIS. None of the nonstructural measures described in the final EIS were carried into the final array of the supplemental EIS as such. This was because the Court did not view these nonstructural measures as true alternative plans but only as measures to be considered in the formulation of a comprehensive nonstructural plan. The formulation of a comprehensive nonstructural plan which was carried into the final array is described in Section IV of this appendix. Measures presented in the final EIS as well as additional nonstructural measures applicable to the Sulphur River flood plain were considered in the formulation of this comprehensive nonstructural plan.

Prior to consideration of the Reservoir and Levees plan and the Reservoir Only plan in the final array for the supplemental EIS, the cost estimates shown in the final EIS were reviewed. Based on experience of the Fort Worth District in construction of similar works in Texas, the cost estimates for these two plans were revised to those shown in table 8.

The US Fish and Wildlife Service (USFWS) completed new fish and wildlife studies in September 1980 and provided updated man-day use, and commercial fishery and trapping estimates for the Reservoir Only and Reservoir and Levees plans. New man-day estimates are presented in tables 9 and 10 for these two plans, and associated benefit analysis is included in Appendix C. These new estimates are used for evaluating these plans in this appendix.

Changes relating to benefits claimed for water supply, storage exchange, and redevelopment for these two plans are also found in Section II of Appendix C. The benefits presented in this supplemental EIS supersede those found in the final EIS and associated documentation.

In studies leading to the supplemental EIS, it was determined that release of the 3,000 cfs design discharge would result in inundation of about 641 acres immediately below the dam and above State Highway 19/154. Since long-term periodic inundation of this area through controlled releases would result in induced damages, a flowage easement was determined to be needed. Subsequent cost estimates for the Reservoir and Reservoir and Levees therefore include a cost of $90,000 for obtaining such an easement (1974 price levels).

TABLE 7

PERTINENT DATA
RESERVOIR AND LEVEES PLAN

Location: The Cooper Lake damsite is located at river mile 23.2 on the South Sulphur River about 3 miles southeast of Cooper, Texas, and 13 miles north of Sulphur Springs, Texas. The lake will inundate portions of Delta and Hopkins Counties.

Purposes: Flood control, municipal and industrial water supply, recreation, and fish and wildlife.

Authorization: Act approved 3 August 1955 (Public Law 218, 84th Congress, 1st Session).

Drainage Area:

	Square Miles
Above USGS gage on South Sulphur River near Cooper	527
Above Cooper Lake damsite	476

Runoff (October 1923 through December 1978):

	Acre-Feet	Inches
Maximum (1957)	754,100	29.70
Minimum (1956)	46,900	1.85
Average	237,000	9.34

Major Floods:

	Peak Discharge at Cooper Damsite (cfs)
December 1971	38,400
May 1969	28,500
April 1966	27,500
February 1965	22,600

TABLE 7 (continued)

Spillway Design Flood	
Duration of Storm	72 hours
Total volume of rainfall	30.9 inches
Average infiltration rate	0.02 inches/hour
Total volume of inflow to full reservoir	29.21 inches (741,250 acre-feet)
Peak inflow to full reservoir	234,790 cfs
Service Spillway:	
Length of crest	200 feet, net
Crest elevation	426.2 feet
Type	Concrete gravity ogee
Control	5 - 40' x 20' Tainter gates
Emergency Spillway:	
Length at Crest	4,200 feet
Crest elevation	450.0 feet
Type	Uncontrolled broadcrested weir
Outlet Works:	
Diversion	
Type	Gated conduits
Number	4
Dimension, each	6 feet x 6 feet
Location	One in each of four gate piers
Invert elevation	398.0 feet
Selective withdrawals	
Type	Two gates in one gate pier
Size	2 feet x 3 feet
Invert elevations	422.0 feet and 436.0 feet
Embankment:	
Top elevation	459.0 feet
Length	15,882 feet
Type	Rolled earthfill
Maximum height	73.0 feet
Freeboard	6.2 feet

TABLE 7 (continued)

Reservoir:

Feature	Elevation (ft msl)	Surface Area (acres)	Pool Capacity Volume (ac-ft)	Pool Capacity Runoff (in)	Total Capacity (ac-ft)
Top of dam	459.0	-	-	-	
Maximum design water surface (Surcharge storage)	452.8	26,563	162,270	6.40	603,670
Guide taking line	451.2	25,595	-	-	-
Emergency spillway	450.0	-	-	-	-
Flood control pool (top of gates)	446.2	22,740	131,400	5.18	441,400
Water supply pool	440.0	19,305	273,000	10.76	310,000
Spillway crest	426.2	-	-	-	-
Sediment pool	415.5	5,084	37,000	1.46	37,000
Stream bed	386.0	0	0	0	0

Reservoir Yield:

Municipal and industrial water supply	164 cfs	(106.0 mgd)
Low flow release	5 cfs	(3.2 mgd)
Total	169 cfs	(109.2 mgd)

Water Supply Contracts:

City of Irving, Texas	100,625 acre-feet
North Texas Municipal Water District	100,625 acre-feet
Sulphur River Municipal Water District	71,750 acre-feet
Total	273,000 acre-feet

Levees:	River	Length
4RSS Spur	South Sulphur	5,000 feet
4LSS Extension	South Sulphur	25,100 feet
3RS Spur	Sulphur	4,284 feet
3RS Strengthening	Sulphur	34,544 feet
3RS Extension	Sulphur	22,000 feet
4RS New	Sulphur	51,600 feet

TABLE 7 (continued)

Channels and Floodway Clearing:	Length
South Sulphur River (with 4LSS)	19,000 feet
Sulphur River (with 4RS)	15,900 feet

TABLE 8

FIRST COST, INVESTMENT, AND ANNUAL OM&R
Reservoir and Levees and Reservoir Only Plans

($1,000 at July 1974 prices; 3-1/4 percent interest;
100-year period of analysis)

Item		Reservoir and Levees	Reservoir Only
COOPER LAKE			
01	Lands and Damages	$ 9,500	$ 9,500
02	Relocations	2,440	2,440
03	Reservoir	2,270	2,270
04	Dam	31,241	31,241
08	Roads	2,135	2,135
11	Levees	245	245
14	Recreation Facilities	2,249	2,249
19	Buildings, Grounds, and Utilities	512	512
20	Permanent Operating Equipment	305	305
	Subtotal	50,897	50,897
	Downstream flowage easement	90	90
	Engineering and Design	3,891	3,891
	Supervision and Administration	3,230	3,230
	TOTAL FIRST COST	$58,108	$58,108
	Interest During Construction (4 years)	3,777	3,777
	TOTAL INVESTMENT	$61,885	$61,885
	Interest and Amortization	2,096	2,096
	Annual Operation and Maintenance	478.5	478.5
	Annual Major Replacements	22.7	22.7
	TOTAL AVERAGE ANNUAL CHARGES	2,598.1	2,598.1
DOWNSTREAM LEVEES AND CHANNELS			
Levees		$ 7,046	
Drainage Structures		10	
Channels		901	
Environmental Protection		385	
	Subtotal	8,342	
Engineering and Design		918	
Supervision and Administration		656	
	Total Non-Federal Cost	158	
	TOTAL FIRST COST	$10,074	

TABLE 8 (continued)

Item	Reservoir and Levees	Reservoir Only
DOWNSTREAM LEVEES AND CHANNELS - continuation		
Interest and Amortization	341.3	
Annual Operation and Maintenance	32.3	
TOTAL AVERAGE ANNUAL CHARGES	$ 373.6	
TOTAL PLAN		
First Cost	$68,182	$58,108
Average Annual Charges	2,971.7	2,598.1

TABLE 9

RECREATION AND FISH AND WILDLIFE AVERAGE ANNUAL
EQUIVALENT MANDAYS
RESERVOIR & LEVEES

Activity	Without Project	With Project	Gain or Loss
General Recreation	0	741,000	+741,000
Sport Fishing			
Stream	2,254	0	- 2,254
Lake	0	192,202	+192,202
Sport Hunting			
Deer	2,496	486	- 2,010
Raccoon	1,108	262	- 846
Rabbit	3,039	1,193	- 1,846
Quail	706	598	- 108
Squirrel	11,944	2,957	- 8,987
Dove	190	190	0
Coyote	917	718	- 199
Fox	366	380	+ 14

NOTE: The mandays for sport fishing and hunting are based on U.S. Fish and Wildlife Planning Aid data furnished October 16, 1980. With and without project mandays are for areas actually affected by the plan.

TABLE 10

RECREATION AND FISH AND WILDLIFE AVERAGE ANNUAL
EQUIVALENT MANDAYS
RESERVOIR ONLY

Activity	Without Project	With Project	Gain or Loss
General Recreation	0	741,000	+741,000
Sport Fishing			
Stream	2,254	0	- 2,254
Lake	0	192,202	+192,202
Sport Hunting			
Deer	1,630	365	- 1,265
Raccoon	702	200	- 502
Rabbit	2,209	913	- 1,296
Quail	616	450	- 166
Squirrel	7,154	1,739	- 5,415
Dove	160	160	0
Coyote	742	505	- 237
Fox	286	326	+ 40

NOTE: The mandays for sport fishing and hunting are based on U.S. Fish and Wildlife Planning Aid data furnished October 16,1980. With and without project mandays are based on areas actually affected by the plan.

SECTION III - WATER SUPPLY WITHOUT FLOOD CONTROL

Deficiency Noted in Memorandum Opinion

One deficiency noted by the Court was the absence of consideration in the final EIS of an alternative to provide water supply without provisions for flood control. The National Environmental Policy Act of 1969 requires that an environmental impact statement must include analyses of all feasible alternatives no matter whether the responsible agency has the authority to implement them. The Court therefore rejected arguments that a water supply alternative should not have been evaluated since the implementation of such a plan would not be the responsibility of the Federal Government under existing authorities. Furthermore, the Court rejected arguments that the Corps had previously considered a water supply only alternative and that pertinent information on the impacts of such a plan could be extracted from data in the final EIS on the multiple-purpose Reservoir Only plan. Regulations of the Council on Environmental Quality specify that an environmental impact statement must be capable of being understood without undue cross referencing. Also, case law mandates that an environmental impact statement must be comprehensible to nontechnical minds. The operating characteristics, and consequently the impacts, of a water supply lake would be somewhat different in terms of pool elevations and releases than those of a multiple-purpose lake.

The Court recognized that water supply was the primary concern of local interests and that it would be financially advantageous to the local sponsors to participate in a multiple-purpose project rather than to construct a water supply project totally at their own expense. This does not, however, relieve the Corps from considering all feasible alternatives, including water supply only, in the final EIS.

In correcting the water supply only alternative deficiency, a water supply needs study was first prepared for the Fort Worth District by the Southwestern Division Office of the Corps of Engineers. The areas studied include those served by the entities that have contracted for water from the proposed Cooper Lake. These are the North Texas Municipal Water District: the city of Irving; and the Sulphur River Municipal Water District which will serve the cities of Commerce, Cooper, and Sulphur Springs (see figure 1 for map of study area). Potential sources of water that could feasibly supply a portion or all of the identified needs of this study area were identified. The potential sources identified include those considered in previous studies of water supply in northeast Texas, as well as other sources such as existing reservoirs, possible new reservoirs, and ground water sources. The water supply needs data were compared with the potential sources and a set of alternative plans to satisfy the needs was developed. From this set of alternatives, the most likely water supply only plan was selected.

Water Supply Needs Study

The municipal and industrial water supply needs for areas served by the Cooper Lake water supply sponsors were forecast and compared with the

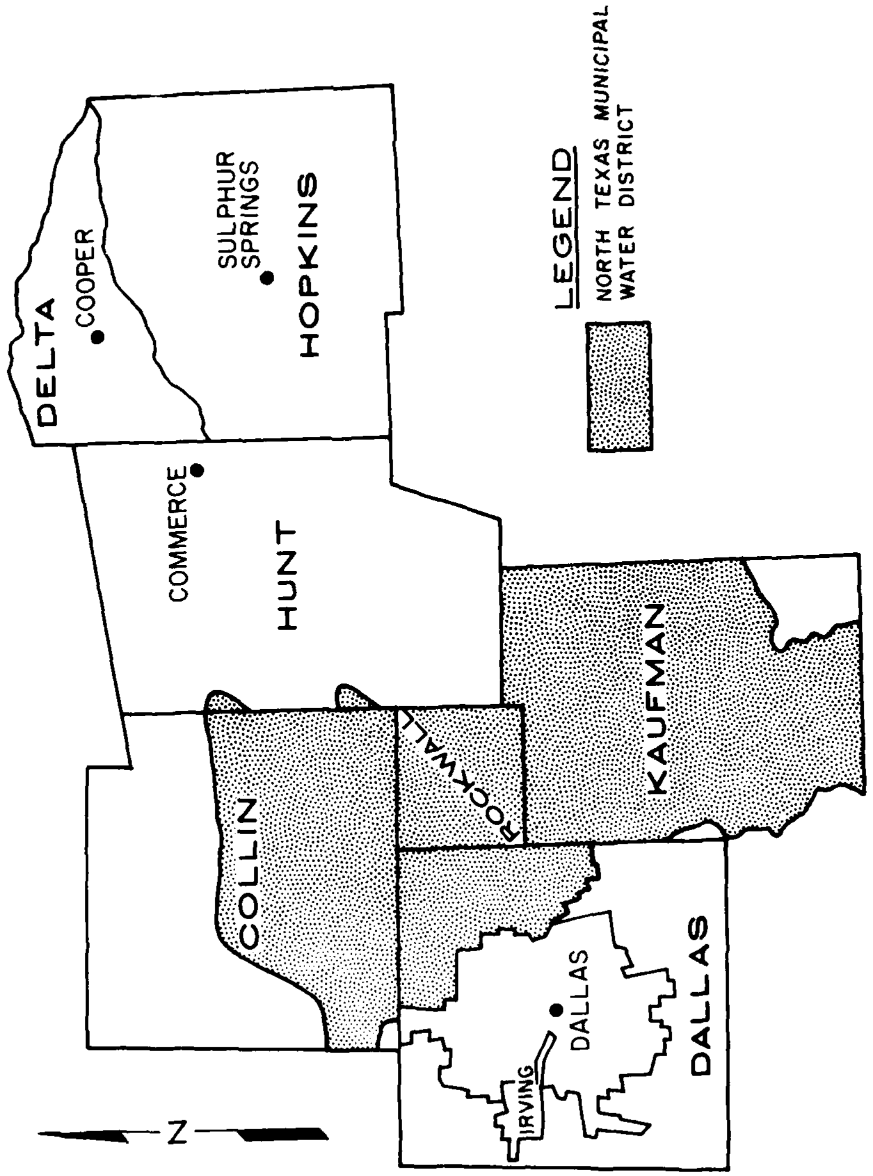

FIGURE 1- STUDY AREA FOR COOPER LAKE WATER SUPPLY NEEDS

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currently available supplies. From this information, net needs were developed. Baseline projections of needs were first made considering no conservation programs other than continuation of those currently in use. The resulting needs were then modified to reflect the implementation of new conservation programs that would reduce overall water use. The total net baseline needs for the study area (North Texas Municipal Water District, city of Irving, and Sulphur River Municipal Water District) range from 13.0 mgd in 1990 to 142.6 mgd in 2040. With implementation of conservation programs, the total net needs range from 7.7 mgd to 121.2 mgd in 1990 and 2040, respectively. A summary schedule of projected needs for the study area is presented in table 11. More detail is available in "Cooper Lake Water Supply Study" dated April 1980 which is exhibit 2 of this appendix.

a. Water Conservation. In estimating the effects of conservation on future municipal water needs, a program was assumed which would reduce both interior and exterior residential water use. For interior residential use, it was assumed that water saving toilets, faucets, and shower heads would be required for all new construction and would gradually, over a 50-year period, replace standard fixtures in existing residences. The estimated per capita water savings in interior residential uses would be 11.81 gallons per day. The effects of external conservation were estimated by reducing the seasonal component of municipal water use by 10 percent. The seasonal component for this study area is defined as that increment of water use above the annual average which occurs generally from June through October and consists primarily of landscape watering. Estimates for future industrial water uses were not modified for conservation programs because past trends in industrial water use reflect increasing recirculation of water, primarily as a response to pollution control laws. Therefore, the baseline protections have automatically incorporated the effects of a substantial conservation program for industrial uses. It should be noted that although consideration of conservation programs would reduce the estimates of future average water needs, it conversely increases the need to plan for contingency supplies. The reason is that the water suppliers would have less operating flexibility during periods of drought or other shortages.

b. North Texas Municipal Water District. The North Texas Municipal Water District (NTMWD) is a quasi state agency that provides water to 11 member cities and 18 customer entities which include smaller cities and water districts. In 1977, NTMWD supplied a total of 62.9 mgd for the municipal and industrial needs of its members and customers. It currently gets its supply of water from Lake Lavon near Wylie, Texas. All of the available water storage in Lake Lavon, which has a dependable yield of 91.8 mgd, is under contract to NTMWD. This will meet the district's needs until about 1985. The net needs will then range from 12.3 mgd in 1990 to 101.9 mgd in 2040 without new conservation efforts. With conservation programs, the range is from 7.0 mgd to 84.1 mgd. A letter from the Executive Director of NTMWD expressing the NTMWD position on these water supply needs projections is exhibited at the end of this appendix.

TABLE 11

NET WATER SUPPLY NEEDS (MGD)

	NTMWD		IRVING		SRMWD		TOTAL	
Year	Baseline	Conservation	Baseline	Conservation	Baseline	Conservation	Baseline	Conservation
1977	--	--	--	--	--	--	--	--
1985	--	--	--	--	--	--	--	--
1990	12.3	7.0	--	--	.72	.71	13.0	7.7
2000	27.8	19.8	--	--	.75	.72	28.6	20.5
2010	41.2	30.8	26.8	24.9	.79	.71	68.8	56.4
2020	58.8	45.7	29.5	27.1	.83	.77	89.1	73.6
2030	78.4	62.4	32.3	29.5	4.07	3.79	114.8	95.7
2040	101.9	84.1	36.0	33.0	4.71	4.13	142.6	121.2

c. City of Irving. The city of Irving, located in Dallas County just west of Dallas, used 16.7 mgd of water in 1977 for municipal and industrial purposes. Irving currently gets its water from two sources. One source, the city of Dallas, will meet its needs until 2007 when their contract expires. It is not likely that the contract will be renewed as the city of Dallas is anticipating a water shortage at approximately that time. Irving also has a contract for well water with the Whalen Corporation that provides a maximum of 5.76 mgd. The contract allows for purchase of these wells after the expiration of the contract, but according to the Texas Department of Water Resources, ground water quality is below standards, and further depletion of the ground water aquifer could cause serious problems such as subsidence and saline water encroachment. Net water supply needs range from 26.8 mgd in 2010 to 36 mgd in 2040. The with-conservation needs range from 24.9 mgd in 2010 to 33 mgd in 2040.

d. Sulphur River Municipal Water District. The other local water supply sponsor is the Sulphur River Municipal Water District (SRMWD) which was formed for the specific purpose of contracting water from Cooper Lake. SRMWD will serve the cities of Commerce, Cooper, and Sulphur Springs.

(1) Commerce. Commerce used approximately 1.7 mgd of water for municipal and industrial purposes in 1978. The city currently obtains its water from Lake Tawakoni through a contract with the Sabine River Authority. Some water is obtained from wells, but it is generally of poor quality and limited quantity. The pipeline from Lake Tawakoni allows for the transportation of a maximum of 3 mgd. If the water contract is not renewed when it expires in 2027, Commerce would have a net need of 3.2 mgd in 2030 and 3.5 mgd in 2040. The needs with conservation programs would be 3.0 mgd in 2030 and 3.3 mgd in 2040.

(2) Cooper. Cooper supplied a total of about 0.35 mgd of water to its customers in 1977. The principal source of water supply for Cooper has been its three city owned lakes. The combined dependable yield of these lakes is extremely small and has historically been augmented through pumping from the South Sulphur River. In 1978, the water supply from these lakes was exhausted, and a pipeline was built to supply water from Lake Sulphur Springs. This was not considered to be a long-term source of water, as their contract with Sulphur Springs expires before 1990.

Cooper has requested funding for a county-wide water supply system with the Ark-Tex Council of Governments and the Farmers Home Administration. The entities that would be supplied with water are currently getting their water from ground water sources which are limited and generally of poor quality according to the Texas Department of Water Resources. The net needs for Cooper and its countywide service area would reach a peak of 0.91 mgd in 2040 without conservation and 0.83 mgd with conservation.

(3) Sulphur Springs. In addition to meeting its own needs of 2.7 mgd, the city of Sulphur Springs in 1978 supplied 0.3 mgd to the city of Cooper and seven rural water districts. The sources of their water are Lake Sulphur Springs and Century Lake which had yields of 7.1 mgd and

1.9 mgd, respectively, in 1978. By 2040, sediment will have reduced these yields to 5.2 mgd and 0, respectively. Based on the current supply and the total municipal and industrial water requirements (excluding Cooper), Sulphur Springs would begin needing an additional source of water between 2030 and 2040. With a conservation program, additional water would not be needed until shortly after 2040.

Initial Water Supply Measures Considered

Potential sources of water supply to meet the needs of the NTMWD, the city of Irving and the SRMWD were explored using various sources of information. Previous water supply studies by private consulting firms were used, along with considering supplies that might be available from existing reservoirs, new reservoir sites, and ground water sources. The geographical area considered was the lower section of the Red River Basin, the Sulphur River watershed, the Cypress Creek watershed, the Sabine River Basin, and the upper portion of the Trinity River Basin. Each of the river basins is discussed in the following paragraphs, and the possible water supply sources for the study area are identified. See figure 2 for a general map of the study area and figure 3 for a more detailed map showing specific locations of the potential water supply sources investigated.

a. Red River Basin. Reservoirs on the Red River and its tributaries can be considered as sources for water supply in Texas contingent upon certain restrictive limitations. Water development in the Red River Basin is subject to the Red River compact, which is an agreement between the States of Arkansas, Oklahoma, Louisiana, and Texas concerning the water in the Red River and its tributaries. The compact has been presented to the Congress for ratification.

Water in the Red River varies in chemical quality because the upper reaches of the Red River Basin contain sources of mineral pollutants that generally degrade the water quality downstream and make it unsuitable for most municipal and industrial uses. Some of the pollution is from oil-field brines, and some is from natural sources. The Tulsa District, Corps of Engineers, has located some of the sources of mineral pollution and is working on a chloride control plan that would improve the quality of the water by the year 2000.

Of the existing and proposed Red River Basin reservoirs that might be usable given the institutional and water quality restrictions, many were dropped from further consideration due to distance from the area of need, limited dependable yield, current use or right to use, or a combination of these factors. Those Red River Basin reservoirs, along with pertinent distance, yield, and water rights parameters are listed in table 12.

Two potential sources of water supply in the Red River Basin have been considered in more detail. One would be to divert water from the Red River below Denison Dam (Lake Texoma) to a tributary of Lake Lavon to mix the water with Lake Lavon water. This would produce water that would meet the

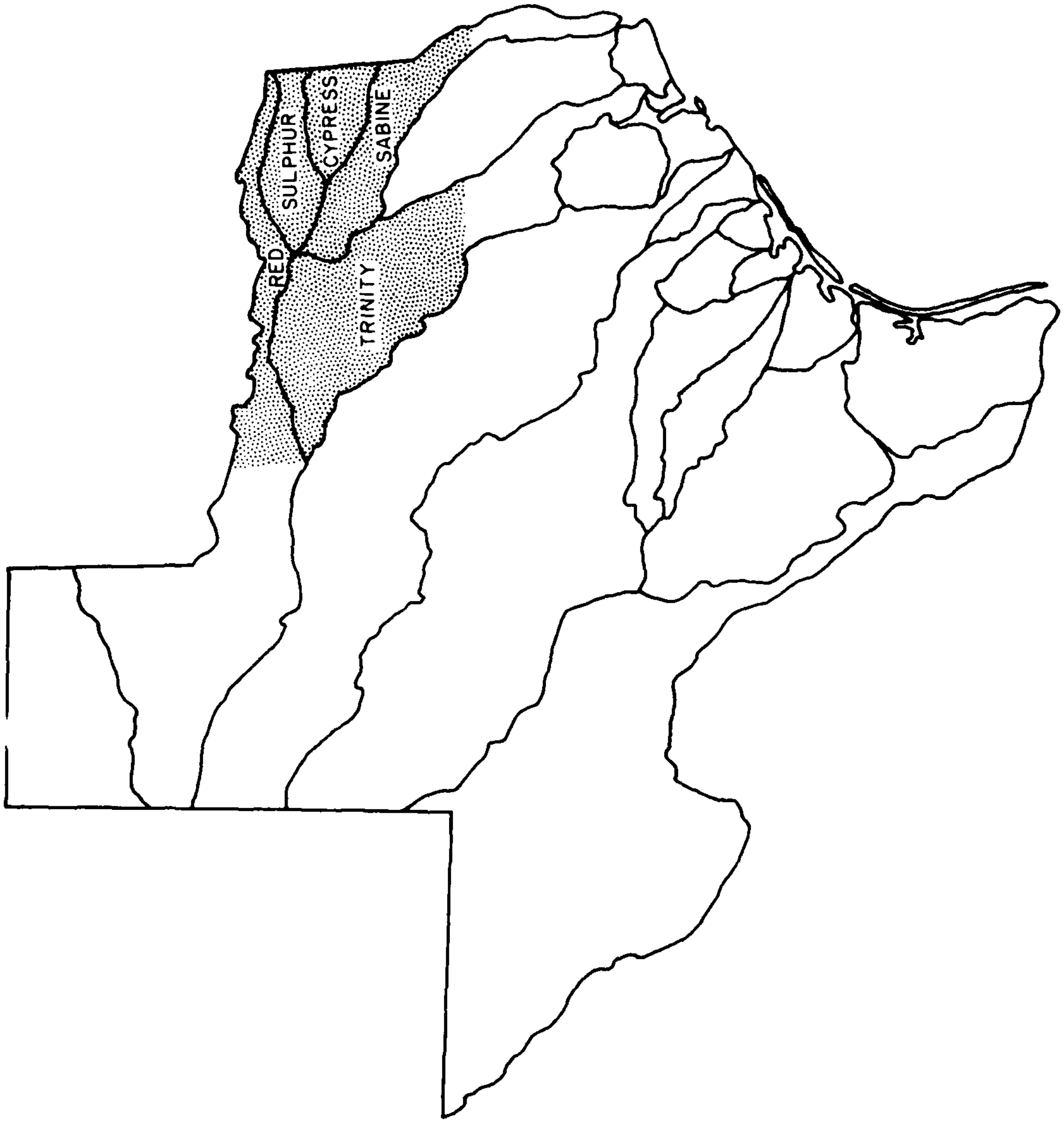

FIGURE 2 - STUDY AREA FOR WATER SUPPLY SOURCES

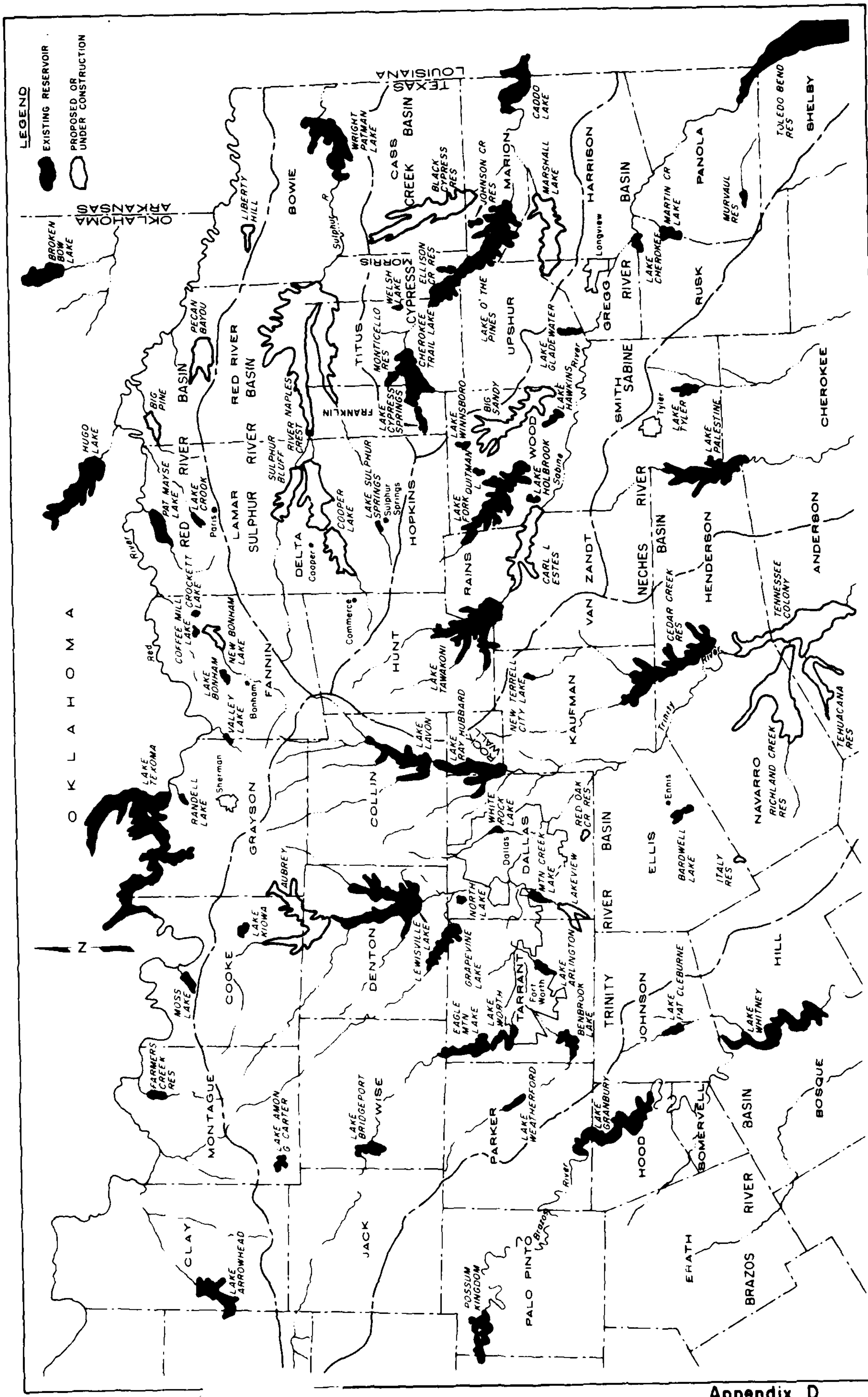

FIGURE 3 - WATER SUPPLY SOURCES INVESTIGATED

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TABLE 12

POTENTIAL SURFACE SOURCES -- RED RIVER BASIN

Reservoir	Local Sponsor	Yield (mgd)	Current Usage (mgd)	Additional Future Usage (mgd)	Surplus (mgd)	Distance (mi) To NTMWD & Irving	Distance (mi) To SRMWD	Major Reason for Elimination from Study	Remarks
Arrowhead	Wichita Falls	37.5	11.35	26.15	0	119	165	No surplus available	Study currently underway to find additional water supply
Farmers Creek	North Montague County Water Supply District	5.3	0.5	-	4.8	66	120	Distance too great, yield too small	Yield not great enough to pump water these distances and sediment will probably reduce yield in future
Moss	Gainesville	5.6	0	5.6	0	50	92	No surplus	Study is currently being done on future needs
Randell	Denison	0 1/	0	-	0	21	61	No available yield	
Valley	Texas Power & Light Company	0 1/	0	-	0	9	44	No available yield	
Bonham	Bonham Municipal Water Authority	5.5	1.2	-	4.3	17	33	Yield too small	Sedimentation will probably reduce yield, and it cannot supply enough water to justify pumping
Coffee Mill	US Forest Service	0 1/	0	-	0	31	35	No available yield	
Pat Mayse	Paris	53.4	12	41.4	0	44	36	Water rights taken	City of Paris in a unanimous vote decided to retain all surplus for future use
Crook	Paris	0 1/	0	-	0	44	29	No available yield	
Big Pine*	--	29.4	0	-	0	60	39	No available yield, no advantages over Cooper	Proposed reservoir
Pecan Bayou*	--	29.4	0	-	0	72	47	No available yield, no advantage over Cooper	Proposed reservoir
Liberty Hill*	--	26.8	0	-	0	101	73	No available yield, no advantage over Cooper	Proposed reservoir
Hugo	Oklahoma	58.0	-	-	-	95	55	Distance too far	There can be legal problems with transporting water across State lines
Broken Bow	Oklahoma	65	-	-	-	115	69	Distance too far	There can be legal problems with transporting water across State lines

1/ Firm yield of reservoir is 0 mgd, but diversions are permitted through State authorizations.

*Proposed

quality requirements of the Texas Department of Health Resources and the Environmental Protection Agency. Another source of water in this basin would be from a proposed reservoir located on Bois d'Arc Creek at approximately river mile 20. It is called New Bonham to distinguish it from the existing Lake Bonham and another proposed reservoir called Bonham Reservoir that has been studied by the Corps of Engineers.

b. Sulphur River Watershed. The Sulphur River watershed is located in northeast Texas and is bounded on the north by the Red River divide and on the south by the Sabine River Basin and Cypress Creek watershed. The water is generally of good quality, but in the lower reaches there are some possible pollution problems from oil field brines. The flood runoff in the area is generally sufficient to dilute these and make the water acceptable for municipal and industrial uses.

Several reservoirs have been proposed for this watershed. These include Sulphur Bluff and Naples Reservoirs, potential projects at the Cooper Lake site, a reservoir on the South Sulphur River at the confluence with Honey Creek, and a site on the North Sulphur River at river mile 30.5. Sulphur Bluff and Naples, while located fairly close to the cities of Cooper, Commerce, and Sulphur Springs, would not offer any advantages over a lake at the Cooper site due to the increased distance from users, particularly the NTMWD and the city of Irving. The yield from the reservoir near Honey Creek would only be about 12.8 mgd. Also, the yield from the reservoir on the North Sulphur River would be small to the extent that it would not offer any advantages over a lake at the Cooper site. These and other reservoir sources in the Sulphur River watershed which were considered and dropped for reasons of distance, yield, and/or water rights factors are shown in table 13.

Based on this preliminary screening analysis, the Cooper site was the only reservoir source in the Sulphur River watershed carried into more detailed analysis.

c. Cypress Creek Watershed. The Cypress Creek watershed is bounded on the north by the Sulphur River watershed and on the south by the Sabine River Basin. Based on the water quality in Lake O'the Pines, water from the Cypress Creek watershed is expected to be quite good. At the present time, approximately two-thirds of the potential water supply from the basin is still uncommitted, but generally the relatively long distance from potential users and/or limited yields of the reservoirs caused them to be dropped from consideration after preliminary screening (see table 14).

d. Sabine River Basin. The Sabine River Basin is bounded on the north by the Sulphur and Cypress Creek watersheds and on the south by the Neches River Basin. The water in this basin is of fairly good quality with a slight salinity problem which is due mostly to oil field drainage in the area. Several of the reservoirs in this basin were built for recreation purposes only and therefore do not have a dependable water supply yield. Some of the other reservoirs have relatively low yields or are too far from potential users to be considered in more detailed analyses. Some of the reservoirs already are used to the limit of their

TABLE 13

POTENTIAL SURFACE SOURCES -- SULPHUR RIVER WATERSHED

Reservoir	Local Sponsor	Yield (mgd)	Current Usage (mgd)	Additional Future Usage (mgd)	Surplus (mgd)	Distance (mi) To NTMWD & Irving	Distance (mi) To SRMWD	Major Reason for Elimination from Study	Remarks
Reservoir at Honey Creek*	--	12.8	0	-	0	14	20	No available yield, no advantage over Cooper	Proposed reservoir
Reservoir on North Sulphur River*	--	- 1/	0	-	-	26	14	No available yield, no advantage over Cooper	Proposed reservoir
Sulphur Bluff*	--	235	0	0	0	53	7	No available yield, no advantage over Cooper	Proposed reservoir
Sulphur Springs	Sulphur Springs Water District	7.1	3.6	3.6	0	47	10	No surplus	Yield will decline and need increase
River Crest	Texas Power & Light Company	0 2/	0	0	0	80	38	No available yield	Cooling reservoir
Naples*	--	740	0	-	0	82	39	No available yield, no advantage over Cooper	Proposed reservoir
Wright Patman	Texarkana	17.9	17.9	0	0	122	79	No surplus	

1/ Small based on similar drainage area
2/ Cooling only
* Proposed

TABLE 14

POTENTIAL SURFACE SOURCES -- CYPRESS CREEK WATERSHED

Reservoir	Local Sponsor	Yield (mgd)	Current Usage (mgd)	Additional Future Usage (mgd)	Surplus (mgd)	Distance (mi) To NTMWD & Irving	Distance (mi) To SRMWD	Major Reason for Elimination from Study	Remarks
Cypress Springs	Franklin C Water Dist Texas Water Development Bd	23.2	7.1	16.1	0	77	35	No surplus, distance too far	Contracts are being negotiated currently for the 16.1 mgd yield now available
Cherokee Trail	Titus Co Fresh Water Sup Dist No. 1, Tex Wat Dev Bd	55.7	55.7	0	0	80	36	No surplus	
Monticello	Tex Utilities	11.8	0.2	-	11.6	80	40	Distance too far	Pipeline costs would be too great for this small a yield
Welsh	SW Electric Power Co	7.6	5.4	2.2	0	95	55	No surplus	Plans for expansion will use the additional 2.2 mgd by 1983
Ellison Creek	Lone Star Steel Co	10.3	10.3	0	0	100	65	No surplus	
Johnson Creek	SW Electric Power Co	3.6	3.6	0	0	110	71	No surplus	
Lake o' the Pines	Northeast Tex Municipal Water Dist	108	4.1	-	103.9	110	75	Distance too far	Cost of pipeline and construction of Black Cypress to assure yield would exceed costs for Cooper
Black Cypress*	--	171	0	-	0	115	76	No available yield	Proposed reservoir
Marshall*	--	253	0	-	0	110	80	No available yield	Proposed reservoir
Caddo	Caddo Lake Levee Dist	54 1/	-	-	0	135	100	No surplus, distance too far	Yield must be shared with LA. Officials feel that there is no surplus even though few records are kept. Currently, plans are underway to increase the height of the dam.

1/ Texas share of total yield which is subject to Red River Compact.
* Proposed

dependable yield. The Sabine River Basin reservoirs initially screened and dropped from further consideration are listed in table 15, along with pertinent distance, yield, and water rights parameters.

e. Trinity River Basin. The Trinity River Basin is located south of the Red River Basin and east of the Brazos River Basin. There are some very serious pollution problems in this basin, especially in the Dallas-Fort Worth metropolitan area, due to sewage treatment plants discharging effluent into the Trinity River. The existing and proposed reservoirs in this basin have no water available for uses other than for those currently holding the water rights or were dropped from more detailed consideration for reasons of distance and/or dependable yield parameters (see table 16).

f. Ground Water. Another consideration for potential water supply was additional utilization of ground water sources. At the request of the Fort Worth District, the Texas Department of Water Resources (TDWR) prepared a report, "Ground Water Resources of the Cooper Lake and Channels Project Area," which is a study on the availability and use of ground water supplies in the study area. A copy of this study is included as exhibit 3 of this appendix. TDWR identified two major aquifers in the study area, the Trinity group and the Carrizo-Wilcox. Minor aquifers identified in the study area are the Woodbine and the Nacotoch. These aquifers could not provide a long-range dependable water supply of adequate quality. There would be problems with extreme pumping lifts, water level declines, saline water encroachment, and undesirable concentrations of iron and fluoride. The rural areas will continue to depend on ground water as a source of water supply, but according to TDWR it is not a dependable long-range source for more populated areas.

(1) Trinity Group. The Trinity group aquifer has water level depths that range from 210 feet to 492 feet. Large water level declines have occurred since 1955 because of serious overdrafts. There would be considerable cost in lifting the water, and saline water encroachment will cause severe water quality problems.

(2) Carrizo-Wilcox. There are currently no large withdrawals of water from the Carrizo-Wilcox aquifer. The quantities are limited, and if developed there could be water quality problems. The water in this aquifer has high concentrations of iron and low pH values. Development of the water from this aquifer would increase the quality problems.

(3) Minor Aquifers. The two minor aquifers would not provide dependable supplies of water. The Woodbine aquifer has high concentrations of iron and fluoride. The water in this aquifer would have to be lifted more than 600 feet in some cases. The Nacatoch aquifer also has high concentrations of fluorides.

g. Return Flows. Return flows were also considered as a possible source of water supply. They generally equal about 60 percent of the average water usage. The effluents are currently discharged into rivers and streams where they are eventually purified through natural processes. These flows contribute to reservoir inflows and are therefore accounted for in the dependable yield of the reservoirs being considered. Return

TABLE 15

POTENTIAL SURFACE SOURCES -- SABINE RIVER BASIN

Reservoir	Local Sponsor	Yield (mgd)	Current Usage (mgd)	Additional Future Usage (mgd)	Surplus (mgd)	Distance (mi) To NTMWD & Irving	Distance (mi) To SRMWD	Major Reason for Elimination from Study	Remarks
Tawakoni	Sabine River Authority	205	46.5	158.5	0	26	28	No surplus	Contracts for remaining yield have been negotiated
Carl L. Estes*	--	88.5	0	-	0	45	34	No available yield, no advantages over Cooper	Proposed reservoir
Lake Fork	Sabine River Authority	145	0	145	0	47	29	No surplus	Currently being impounded, and there are contracts for the available water
Holbrook	Wood County	0 1/	0	0	0	57	43	No available yield	Recreation and flood control reservoir
Quitman	Wood County	0 1/	0	0	0	57	33	No available yield	Recreation and flood control reservoir
Winnsboro	Wood County	0 1/	0	0	0	62	36	No available yield	Recreation and flood control reservoir
Big Sandy*	--	68.6	0	-	0	65	38	No available yield, no advantages over Cooper	Proposed reservoir
Hawkins	Wood County	0 1/	0	0	0	75	53	No available yield	Recreation and flood control reservoir
Gladewater	Gladewater	4.6	0.9	-	3.7	92	5	Small yield	Sedimentation will probably reduce the yield and since no projections have been made on future use, it is possible the surplus will be needed.
Cherokee	Cherokee Water Co	16	16	0	0	114	87	No surplus	
Martin Creek	Texas Utilities	33	-	-	-	124	97	Distance too far	No data available on current or projected use
Murvau'	Panola County Fresh Water Sup District No. 1	21	-	-	-	133	114	Distance too far	No data available on current or projected use
Toledo Bend	Sabine River Authority	848 2/	1	-	847	160	135	Distance too far	Cost for pipeline would be greater than cost of Cooper

1/ Recreation and flood control only
2/ Texas share
* Proposed

TABLE 16

POTENTIAL SURFACE SOURCES -- TRINITY RIVER BASIN

Reservoir	Local Sponsor	Yield (mgd)	Current Usage (mgd)	Additional Future Usage (mgd)	Surplus (mgd)	Distance (mi) To NTMWD & Irving	Distance (mi) To SRMWD	Major Reason for Elimination from Study	Remarks
Amon G. Carter	Bowie	0.3	0.3	0	0	75	122	No surplus	
Bridgeport	Tarrant Co Water Control & Imp Dist #1 (TCWCID #1)	60	3.5	0	0	70	120	No surplus	Diversions are made to Eagle Mountain Lake and water is pumped from it.
Eagle Mountain	TCWCID #1	24	80.5	0	0	57	105	No surplus	Same as above
Worth	Fort Worth	1.3	1.3	0	0	57	105	No surplus	
Weatherford	Weatherford	1.6	1.6	0	0	68	118	No surplus	
Aubrey	Dallas, Denton	75.6	0	75.6	0	36	73	No surplus	Currently under construction
Lewisville	Dallas, Denton	106.6	106.6	0	0	24	66	No surplus	
Ray Hubbard	Dallas	58	54.3	3.7	0	2	45	No surplus	1980 usage was in excess of 54.3 mgd
Lavon	NTMWD	91.8	68.3	23.5	0	0	43	No surplus	Projected 1985 usage is 91.8 mgd
Grapevine	Dallas, Park Cities, Grapevine, Dallas Co	18.4	18.4	0	0	33	78	No surplus	
Benbrook	Ft Worth, Benbrook Water & Sewer Auth (BWSA)	6.5	0.5	-	6	70	120		Ft Worth has water rights to o 7 mgd, BWSA has water rights to 2.1 mgd, and 3.7 mgs is currently being contracted for by Ft Worth.
Arlington	Arlington, TX Elec Svc Co	4.3	4.3	0	0	50	97	No surplus	
Lakeview	Dallas Pwr & Light Co, Trinity River Authority	14.2	0	14.2	0	55	91	No surplus	Currently under construction
Mountain Creek	Dallas Pwr & Light Co	0.5	0.5	0	0	47	90	No surplus	
Kiowa	Lake Kiowa, Inc.	7	0	-	0	35	75	No available yield	The corporation cannot sell water
North	Dallas Pwr & Light Co	9.4	9.4	0	0	31	73	No surplus	
White Rock	Dallas	10.7	0	-	0	24	66	No surplus	Reserved for emergency use
Italy*	--	4.5	0	-	0	62	100	No available yield	Proposed reservoir
New Terrell City	Terrell	1.5	1.5	0	0	26	50	No surplus	
Red Oak Creek*	--	17	0	-	0	42	80	No available yield	Proposed reservoir
Cedar Creek	TCWCID #1	156	39.6	116.4	0	47	62	No surplus	In 1980, usage was in excess of 75 mgd. All available yield is expected to be required at some future date.
Richland Creek*	--	198	0	-	0	73	95	No available yield	Proposed reservoir
Tehuacana*	--	41.8	0	-	0	78	100	No available yield	Proposed reservoir
Tennessee Colony*	--	353	0	-	0	75	92	No available yield	Proposed reservoir

*Proposed

flows could not be used directly for general municipal and industrial uses unless the effluents were treated to drinking water standards. This would require a high standard of treatment which would be quite costly. There also could be considerable social concern over direct utilization of effluents.

Water Supply Alternatives Developed

From the initial measures considered, a list of the most promising water supply measures for the study area was developed. The three most likely available sources found were diversion of water from the Red River below Lake Texoma, New Bonham Lake, and a lake at the Cooper site (see figure 4). Six alternave plans for water supply were then formulated through various combinations of the most promising measures to develop a total of 109 mgd. In order for the costs of the water supply alternatives to be comparable, pipeline costs were included. These costs, where applicable, were for appropriate pipelines to Lake Lavon for supply to the NTMWD and the city of Irving, and to the Cooper area for supply to the SRMWD. Pipeline and pumping costs were estimated with the assistance of a command-oriented computer program (MAPS) developed by the Waterways Experiment Station for use in design and evaluation of water and wastewater plans.

a. Most Promising Measures. The diversion from the Red River, New Bonham Lake, and Cooper Lake water supply measures and associated pipelines are discussed in the following paragraphs. Costs of these measures and acres of terrestrial habitat affected by the lakes are displayed in tables 17 and 18, respectively.

(1) Red River Diversion. This measure would involve diverting water from a southerly bend in the Red River approximately 19 miles below the Denison dam. A 60-inch pipeline would be 13.7 miles in length and would flow into Pilot Grove Creek, a tributary of Lavon Lake. About 49 mgd would be available from normal releases from Lake Texoma if releases are as frequent as they have been in the past. Transmission losses of approximately 10 percent are included for movement of water approximately 32 miles down the natural river channel into Lavon Lake.

There has been concern over the quality of water in Lake Texoma. The chemical quality records of the Lake Texoma discharge indicate that some improvement has occurred during the period from 1968-1977. Once the water is mixed with Lake Lavon water and treated, it would be well within the standards of the Texas Department of Health Resources and the Environmental Protection Agency. The Corps of Engineers has been studying a chloride control plan that will bring the quality of Red River water at this withdrawal point within Texas Department of Health Resources and Environmental Protection Agency standards without mixing with Lake Lavon water. One advantage of diverting the water below Denison dam is that there are 581 square miles of intervening drainage area that will dilute the Lake Texoma water.

This measure would have little impact on terrestrial wildlife resources other than the initial construction impacts. However, the interbasin

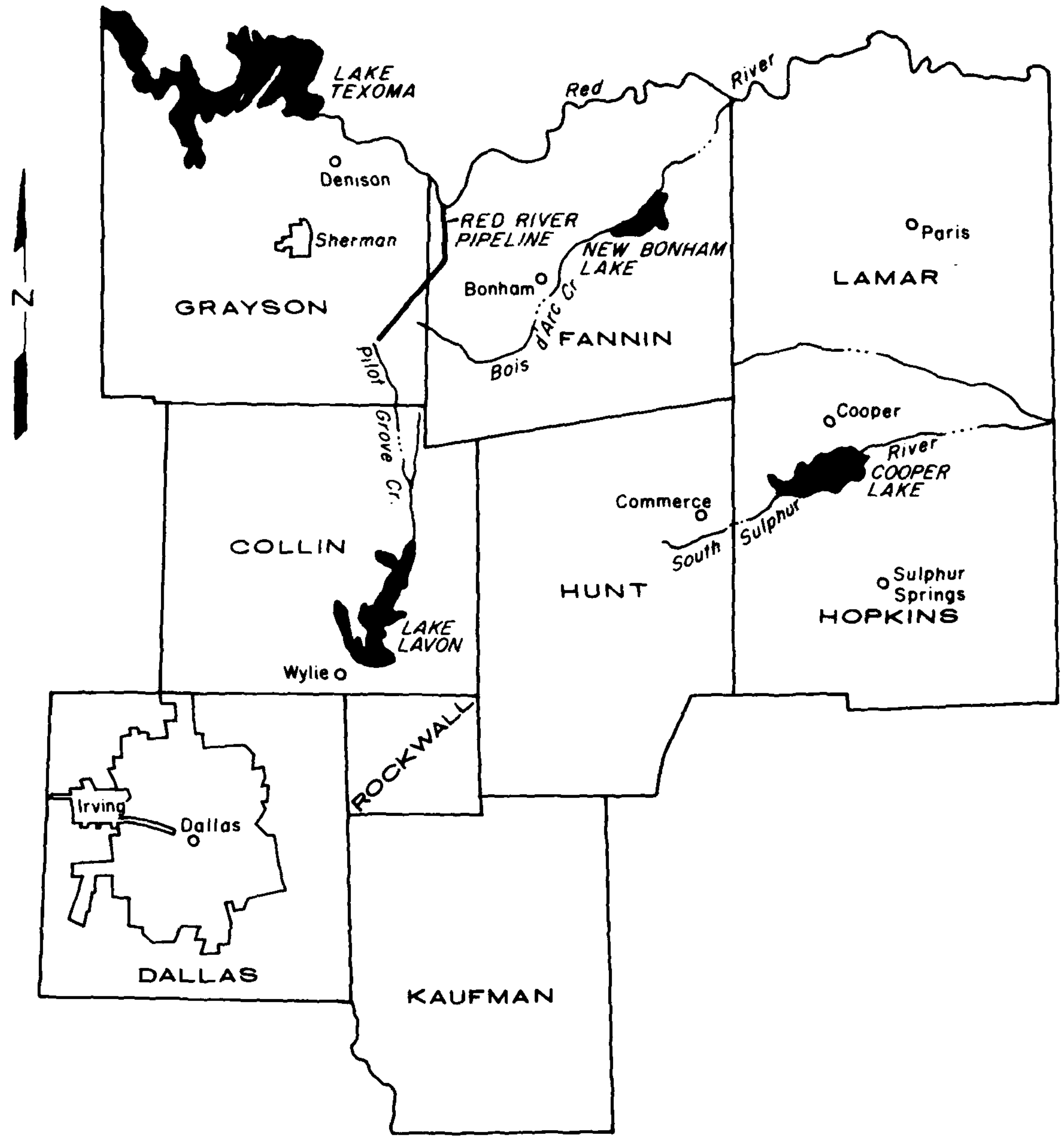


FIGURE 4 - COMPONENTS FOR WATER SUPPLY ALTERNATIVES

TABLE 17

TERRESTRIAL HABITAT AFFECTED

10 mgd Cooper Lake	Wooded	Semiwooded	Openland	Total
Water supply pool	1,805	1,773	2,322	5,900
Dam, perimeter clearing, borrow areas, other construction activities	154	127	341	622
Guide-taking line	410	158	1,010	1,578
				8,100
Stage I Cooper Lake 1/				
Water supply pool	3,135	3,080	4,035	10,250
Dam, perimeter clearing borrow areas, other construction activities	367	366	781	1,514
Guide-taking line	3,102	2,848	4,361	10,311
				22,075
Stage II Cooper Lake and 109 mgd Cooper Lake				
Water supply pool	5,905	5,800	7,600	19,305
Dam, perimeter clearing, borrow areas, other construction activities	504	419	1,117	2,040
Guide-taking line	195	75	460	730
				22,075
New Bonham Lake				
Water supply pool	2,833	2,782	3,645	9,260
Dam, perimeter clearing, borrow areas, other construction activities	310	195	704	1,209
Guide-taking line	172	66	423	661
				11,130

1/ Assumes lands for Stage II lake are bought initially, with the exception of some additional clearing in the year 2010.

TABLE 18

COSTS OF WATER SUPPLY MEASURES
($1,000)

	FIRST COST	ANNUAL OM&R
Red River Diversion and Pipeline (49 mgd)	$10,890	$682.5
New Bonham Lake (62 mgd)	42,433	133.5
Pipeline to Lake Lavon tributary	24,230	872.9
Pipeline to Cooper area	2,694	21.3
Cooper Lake (10 mgd)	29,122	77.1
Cooper Lake (Stage I - 60 mgd)	52,829	183.2
Cooper Lake (Stage II - 49 mgd)	11,776	0
Pipeline to Lake Lavon tributary (Stage I)	37,070	484.0
Pipeline to Lake Lavon tributary (Stage II)	275	356.9
Cooper Lake (109 mgd)	53,301	183.2
Pipeline to Lake Lavon tributary (Stage I)	37,070	484.0
Pipeline to Lake Lavon tributary (Stage II)	275	356.9

transfer of water into 32 miles of tributary stream could cause some potential aquatic impacts, particularly with the more saline water of the Red River. Also, the average flow rate in the Trinity River Basin would slightly increase while the average flows in the Red and Mississippi Rivers would decrease over a period of time.

(2) New Bonham Lake. New Bonham Lake would be located on Bois d'Arc Creek in Fannin County, Texas. This is a project considered in a report prepared in 1979 for NTMWD.[1] The water supply reservoir would have 130,000 acre-feet of conservation storage with a dependable yield of 62.7 mgd. Pat Mayse Lake, which is located not far from the New Bonham site has very good equality water, and the water from New Bonham Lake is expected to be similar.

A pipeline to supply water to the NTMWD and the city of Irving from New Bonham Lake would be a little over 28 miles in length and 66 inches in diameter. Two pump stations would be required to provide the necessary flow. A pipeline from New Bonham to Cooper is called for in one water supply plan. It would also be about 28 miles in length but only 10 inches in diameter.

The adverse environmental effects on New Bonham Lake would be similar to those at Cooper Lake, with the impacts transferred to a different location. Any archeological sites can be salvaged. The required pipelines would have little impact beyond the initial construction effects. Interbasin transfer of water would slightly affect the average flows in the Trinity and Red River Basins.

(3) Cooper Lake. The Cooper Lake damsite is located at river mile 23.2 on the South Sulphur River in Delta and Hopkins Counties, Texas. Three different versions of the lake were considered: a lake with 109 mgd yield, one with 10 mgd yield, and a staged lake with 60 mgd available initially and 49 mgd available 20 years later.

A pipeline to supply water to the NTMWD and the city of Irving would extend approximately 37 miles from Cooper Lake to Lake Lavon. This pipeline, which applies to both the 109 mgd and staged versions of Cooper Lake would be 72 inches in diameter and would require 2 pumping stations. In 2010, additional pumping capacity would be required to meet increased water supply demands.

The full size water supply lake with 109 mgd yield will contain 273,000 acre-feet of water storage. About 19,000 acres of terrestrial habitat would be inundated initially by this project. The lake, with a yield of 10 mgd, would have basically the same effect but on a much smaller scale. A lake this size has reduced impacts on terrestrial habitat, but recreation value and the potential lake fishery are also reduced. The staged lake would delay some of the terrestrial impacts

[1] Study of Potential Sources of Additional Surface Water Supply in the Red River Basin and the Cypress Creek Basin, 1979, Freese and Nichols, Inc.

for 20 years, and if all lands required were bought initially, they could be managed for wildlife during interim operation. Again, the recreation and lake fishery benefits would be discounted.

b. Water Supply Plans. From the three most promising measures just described, six alternative plans were formulated to provide a total dependable yield of 109 mgd and deliver the water to the general vicinity of need in accordance with the water supply needs study. Plan No. 1 consists of obtaining 49 mgd from the Red River in 1990 and 62 mgd from New Bonham in 2000 and diverting the water into the Lake Lavon watershed allowing approximately 10 percent for transmission losses through the tributaries of Lake Lavon. Water for the member cities in the SRMWD would be provided by a small water supply lake with a yield of 10 mgd at the Cooper Lake site in 1990. Several of the other plans utilize the same supply sources, but they would be built in different years. Plan No. 2 involves New Bonham Lake being constructed first along with the 10 mgd yield Cooper Lake. The diversion from the Red River would be constructed in 2010. Plan No. 3 would be to construct a lake at the Cooper site in two stages with 60 mgd available in 1990 and the remaining 49 mgd available in 2010. Plan No. 4 would be to construct Cooper Lake to provide the full 109 mgd in 1990. Plan No. 5, which is somewhat different from the previous ones, involves obtaining 49 mgd from the Red River in 1990, 62 mgd from New Bonham Lake in 2000, and 10 mgd from Cooper Lake in 2020. The city of Cooper would continue to obtain its supply from Sulphur Springs Lake until the time that the lake at the Cooper site is built. Plan No. 6 involves constructing New Bonham Lake in 1990 and diverting water from the Red River in 2010. In this plan, the city of Cooper would obtain water from New Bonham Lake until 2020 when a 10 mgd yield Cooper Lake would be built. Table 19 shows at a glance each feature of the six alternative water supply plans, the yield each would provide, and the year required. Table 20 provides average annual costs, by features, of the six alternative plans. Each of the six plans is evaluated in the following paragraphs.

(1) Plan No. 1. This plan involves obtaining 49 mgd from the Red River and building a lake at the Cooper site with a yield of 10 mgd in 1990. By the year 2000, New Bonham would be constructed to provide 62 mgd. The reduced size lake at the Cooper site would impact only about 25 percent of the acreage of a 109 mgd Cooper Lake. The New Bonham project would transfer about 50 percent of the terrestrial wildlife habitat impacts (in terms of acreage affected) of a full size Cooper Lake to the New Bonham site and delay them 10 years. While the Red River pipeline would not cause significant impacts other than the initial construction impact, there would be potentially significant aquatic impacts due to the interbasin transfer of water of different quality into Lake Lavon. The chloride concentration in the Red River Basin could have an impact on the Trinity River Basin. Also, the flows in the Red and Mississippi River Basins would be reduced slightly while the flows in the Trinity Basin would be increased. The total average annual cost for this plan would be $4.7 million.

TABLE 19

WATER SUPPLY PLANS FORMULATED

	WATER SUPPLY PLAN NO.					
Year Built	1	2	3	4	5	6
1990	Red River 49 mgd Cooper 10 mgd	New Bonham 62 mgd Cooper 10 mgd	Cooper Stage I 60 mgd	Cooper 109 mgd	Red River 49 mgd	New Bonham 62 mgd
2000	New Bonham 62 mgd				New Bonham 62 mgd	
2010		Red River 49 mgd	Cooper Stage II 49 mgd			Red River 49 mgd
2020					Cooper 10 mgd	Cooper 10 mgd

TABLE 20

AVERAGE ANNUAL COSTS FOR WATER SUPPLY ALTERNATIVES
(1974 Price Level; 3-1/4 Percent Interest, 1990-2090 Period of Analysis)

	WATER SUPPLY PLAN NO.					
	1	2	3	4	5	6
Red River Diversion	1,069,600	550,500 2/			1,069,600	550,500 2/
New Bonham Lake	1,207,400 1/	1,664,600			1,207,400 1/	1,664,600
Cooper Lake 10 mgd	1,127,900	1,127,900			430,000 4/	430,000 4/
Cooper Lake 109 mgd				2,106,400		
Cooper Lake Staged			2,299,800 3/			
Pipeline- New Bonham Lake to Lake Lavon tributary	1,249,100 1/	1,733,800			1,249,100 1/	1,733,800
Pipeline-Cooper Lake to Lake Lavon			1,987,500 3/	1,987,500 3/		
Pipleline-New Bonham Lake to Cooper area						109,400
TOTAL	4,654,000	5,076,800	4,287,300	4,093,900	3,956,100	4,488,300

1/ Discounted from 2000 to 1990.

2/ Discounted from 2010 to 1990.

3/ Stage II discounted from 2010 to 1990.

4/ Discounted from 2020 to 1990.

(2) Plan No. 2. The second plan involves constructing New Bonham Lake (62 mgd) and the smaller Cooper Lake (10 mgd) in 1990. The Red River diversion (49 mgd) would be delayed until 2010. Again the impacts in terms of average affected by lakes would be about 75 percent of a full sized Cooper Lake, but all would occur in 1990. The delay in building the Red River project would allow for a predicted improvement in the quality of Red River water and therefore could reduce some of the potential aquatic impacts. The annual cost would be approximately $5.1 million.

(3) Plan No. 3. The third plan would be to construct a two-stage Cooper Lake. The first stage would provide 60 mgd in 1990, and stage II would provide 49 mgd in 2010. This measure would have the full impact of the Cooper Lake, but about half of the terrestrial impacts would be delayed for 20 years. The full recreation and lake fishery benefits would also be delayed for that amount of time. However, if all lands were bought initially, they could be managed for wildlife enhancement during the 20-year interim period. The average annual cost would be $4.3 million.

(4) Plan No. 4. This plan involves constructing Cooper Lake to provide the full 109 mgd in 1990. This would affect 19,000 acres of terrestrial habitat, of which 9,000 acres of wildlife habitat would be inundated for 20 years before an identified need for the associated water supply. In this case, however, all of the impacts would be in one location, and the pipeline to supply water to NTMWD and Irving would have little effect beyond the initial construction impacts. The average annual cost of this plan would be $4.1 million.

(5) Plan No. 5. For this plan, the Red River diversion would be built in 1990, New Bonham in 2000, and the small Cooper Lake in 2020. The city of Cooper would obtain its water from Sulphur Springs Lake until the small Cooper Lake is constructed. This has about the same impacts as Plan No. 1, but the impact to 5,900 acres of wildlife would be delayed for 30 years due to building the small Cooper Lake in 2020. Annual cost for this plan would be $4.0 million.

(6) Plan No. 6. The last plan considered would be to construct New Bonham in 1990, the Red River diversion in 2010, and the small Cooper Lake in 2020. The city of Cooper could obtain water by pipeline from New Bonham Lake until 2020 in this case. This plan has about the same impacts as Plan No. 2, but again, the impact of the 5,900 acres for the small Cooper Lake would be delayed for 30 years. This has an annual cost of $4.5 million.

Selection of Best Water Supply Alternative

Primary concerns in selecting the most likely water supply only alternative were costs, environmental impacts, and implementability. Centralized environmental impacts were considered to be generally more desirable than dispersed impacts of similar total magnitude. The most likely water supply only alternative is Plan No. 4, which is the 109 mgd Cooper Lake. The total average annual cost of this plan is $4,093,900.

which makes it the second least expensive of the six plans, since Plan No. 5 has total average annual cost of $3,956,100. Plan No. 5 was rejected for two major reasons. First, the plan requires that the city of Cooper rely on Lake Sulphur Springs to meet its needs until year 2020. Although the Corps of Engineers needs study indicates viability for such an arrangement, city officials of both Cooper and Sulphur Springs have emphasized that the existing service was intended to last only until a more dependable source of water is developed. The existing pipeline and pumping facilities were designed to be temporary and do not have the capacity of meeting future peak demands in Cooper. Secondly, Plan No. 5 was rejected also for dispersed environmental impacts. With Plan No. 5, as well as with the more expensive Plans 1, 2, and 6, adverse environmental impacts will occur at Cooper Lake, New Bonham Lake, and the Red River diversion; whereas, with Plan No. 4 the disruption of a similar total number of acres will occur only at the Cooper Lake site (see table 7).

The environmental impacts of a staged lake (Plan No. 3) would be somewhat more acceptable than those of a lake initially constructed and filled to its ultimate size. The staged lake was shown to be more expensive, however, due to redundancies in design and construction requirements. Also, the full recreation potential of a staged project would be delayed.

A lake map for the water supply only lake is presented as figure 5. Table 21 gives pertinent data, and table 22 presents a detailed breakdown of the 1974 cost of the 109 mgd Cooper Lake designed to provide water supply without flood control. Pipeline and pumping costs will be omitted from this point on, since this plan will be further evaluated with multiple-purpose lakes at the Cooper site. Costs of a fish and wildlife mitigation plan will be added in section VI.

Recreation Features of the Water Supply Alternative

Recognizing that any public body of water will attract recreation visitors, the water supply only alternative will include minimum facilities to provide for the health and safety of these visitors. This is consistent with recognized health and safety standards and generally with the practice of non-Federal water supply developers in the State of Texas. These facilities would consist of guardrails, turnarounds, and frame toilets at five locations on existing road ends and guardrails and turnarounds at five other locations on existing road ends. The 1974 cost of these facilities, as shown in the 14 account in table 22, is $780,000. Additionally, the public would have access to two boat ramps which would be provided primarily for proper management of project lands and waters. The estimated 1974 cost of these boat ramps is $82,000 and is included in the 03 account in table 22.

The lake would serve an average annual use of 280,000 recreation days over the life of the project, including existing hunting potential on project lands. The average annual equivalent mandays with and without the project are shown in table 23.

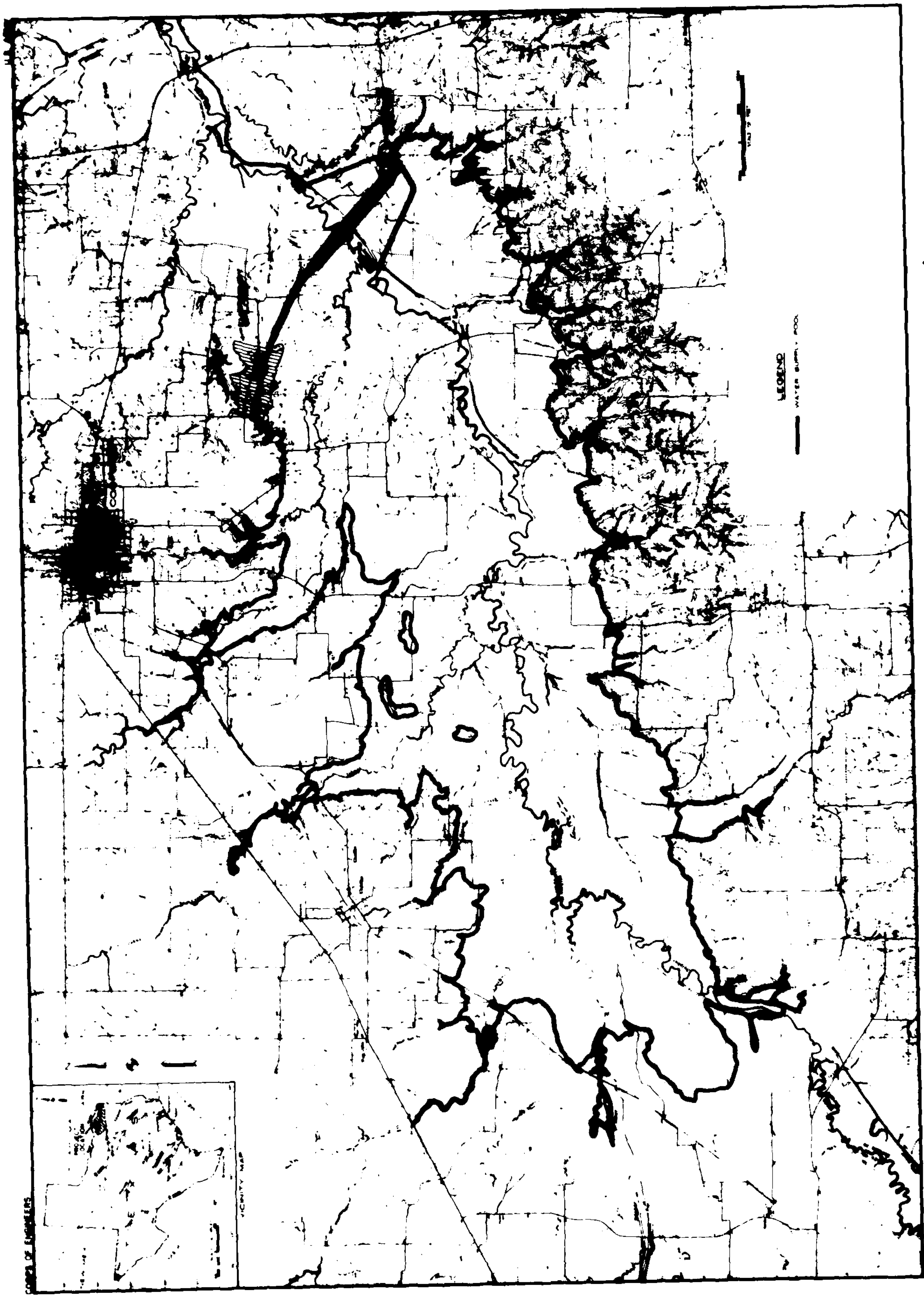


FIGURE 5 - LAKE MAP (WATER SUPPLY ONLY)

TABLE 21

PERTINENT DATA
Cooper Lake -- 109 mgd Water Supply Only

Location: River mile 23.2 of the South Sulphur River

Purposes: Water supply with minimum recreation facilities for health and safety

Drainage Area: 476 square miles

Type of Dam: Earthfill

Spillway: 275 feet concrete service spillway with crest of uncontrolled ogee at elevation 440.0 feet. 4,200 feet uncontrolled emergency spillway with crest at elevation 449.8 feet

Outlet Works: 5 feet diameter gated conduit with intake invert at elevation 410.0 feet

Reservoir:

Feature	Elevation (ft msl)	Surface Area (acres)	Pool Capacity (acre-feet)	Total Capacity (acre-feet)	Spillway Discharge (cfs)
Top of dam	459.8	--	--	--	--
Maximum design water surface	454.3	27,494	231,936	646,224	157,000
Guide taking line	445.0	22,075	104,288	414,288	--
Water supply pool	440.0	19,305	273,000	310,000	--
Sediment pool	415.5	5,084	37,000	37,000	--
Stream bed	386.0	0	0	0	--

Reservoir Yield: 109 mgd (169 cfs)

TABLE 22

FIRST COST, INVESTMENT, AND ANNUAL OM&R
Cooper Lake -- 109 mgd Water Supply Only

(1000's of dollars; 1974 price level)

Account Number	Item	Cost
01	Lands and damages	$ 9,215
02	Relocation	2,440
03	Reservoir	2,329
04	Dam	30,797
08	Roads	512
11	Levees	245
14	Recreation Facilities	780
19	Buildings, grounds and utilities	194
20	Permanent operating equipment	192
Subtotal		$46,704
Engineering and Design		3,561
Supervision and Administration		3,036
Total First Cost		$53,301
Interest During Construction (4 years at 3-1/4%)		3,465
Total Investment		$56,766
Annual Operation, Maintenance, and Replacements		$183.2

TABLE 23

RECREATION AND FISH AND WILDLIFE AVERAGE ANNUAL
EQUIVALENT MANDAYS
WATER SUPPLY ONLY

Activity	Without Project	With Project	Gain or Loss
General Recreation	0	182,000	+182,000
Sport Fishing			
Stream	-2,254	0	-2,254
Lake	0	96,000	+96,100
Sport Hunting			
Deer	1,064	178	-886
Raccoon	452	115	-337
Rabbit	1,420	380	-1,040
Quail	378	197	-181
Squirrel	4,522	997	-3,525
Dove	109	109	0
Coyote	435	165	-270
Fox	179	222	+42

NOTE: The mandays for sport fishing and hunting are based on US Fish and Wildlife planning aid data provided October 16, 1980. With and without project mandays are based on areas actually affected by the plan.

The general recreation benefits expected to result from the lake are based upon projected initial recreational use and the day use unit value for the activity. The initial and future fish and wildlife benefits were converted to average annual values based on an interest rate of 3-1/4 percent with a 100-year project life (1990-2090). The total average annual fish and wildlife benefits consist of the initial benefits plus the discounted future benefits. Table 24 summarizes the unit values used to compute the recreation benefits. A summary of the average annual equivalent values is presented in table 25. Commercial fishery benefits for the water supply only plan are estimated at $8,864, and trapping loss of pelt value is about $1,285 annually.

TABLE 24

UNIT VALUES

Activity	Value
General Recreation	$0.75
Stream Fishing	1.50
Lake Fishing	1.50
Deer Hunting	6.00
Raccoon Hunting	2.00
Rabbit Hunting	2.00
Quail Hunting	2.00
Squirrel Hunting	2.00
Dove Hunting	2.00
Coyote Hunting	2.00
Fox Hunting	2.00

TABLE 25

SUMMARY OF RECREATION AND FISH AND WILDLIFE BENEFITS
(Average Annual Equivalent Values)
WATER SUPPLY ONLY

Activity	Without Project	With Project	Gain or Loss
General Recreation	$ 0	$136,500	$136,500
Sport Fishing			
Stream	3,381	0	-3,381
Lake	0	144,150	+144,150
Sport Hunting			
Deer	6,384	1,068	-5,316
Raccoon	904	230	-674
Rabbit	2,840	760	-2,080
Quail	756	394	-362
Squirrel	9,044	1,994	-7,050
Dove	218	218	0
Coyote	870	330	-540
Fox	358	444	+86

SUMMARY:		ROUNDED TO
General Recreation	$136,500	$136,500
Sport Fishing	140,919	140,800
Sport Hunting	-15,936	-15,900

SECTION IV - NONSTRUCTURAL FLOOD PLAIN MANAGEMENT

Deficiency Noted in Memorandum Opinion

The Court acknowledged that the final EIS listed four nonstructural alternatives - zoning, flood plain acquisition, flood insurance, and flood warning and evacuation. These alternatives were discussed separately without reference to each other. The Court found that a comprehensive plan should have been presented proposing the integrated use of nonstructural measures. The Court also found that information in the final EIS on the nonstructural measures was misleading and that the associated benefit-cost analyses were incomplete. Since the Corps of Engineers is required to consider nonstructural flood plain management as an alternative and is authorized to recommend and implement such an alternative in appropriate circumstances, the Court found the final EIS insufficient with regard to presentation of a nonstructural flood plain management alternative.

Nonstructural Flood Damage Reduction

Measures intended to reduce flood damages nonstructurally deal with accommodating floods rather than altering the stage or the course of floodwaters. In most cases, nonstructural measures affect activities in the flood plain, while structural measures affect the hydraulics of the flood plain. Thus, successful implementation of nonstructural measures generally involves altering human behavior. This fact alone makes it complex and difficult to predict and measure the potential benefits of such an action. Traditionally, varying degrees of resistance from residents have met government attempts to control private actions in flood plains. Whether true or not, local interests generally perceive limited or reduced property values and restricted activities resulting from nonstructural measures. This produces an appeal for nonstructural measures from a national or regional viewpoint because many of the social and economic costs are borne by the local interests and not by the nation as a whole, but discourages acceptance by local interests. The present system of project conception and implementation depends heavily on the support of local benefited interests. Therefore, local acceptance of nonstructural projects is essential to their implementation. Strong public involvement programs have been found to be effective in gaining public support for nonstructural solutions to flood problems.

One of the main thrusts of nonstructural measures is to manage or control future flood plain land use in order to prevent encroachment and future increases in flood damages and to guide or regulate human behavior to achieve other goals or values perceived by society for proper use of flood plains. These perceived societal values of flood plains include fish and wildlife habitat; water quality maintenance; natural moderation of floods; ground water recharge; cultural resources; and agricultural, aquacultural, or forestry resource conservation. Several nonstructural measures have also proven effective in reducing existing flood damages. These include floodproofing existing structures, temporary and/or permanent evacuation, flood warning systems, and land use changes.

The confidence level of calculating future benefits and costs for structural changes to a flood plain (dams, levees, or channels) is inherently much greater than for nonstructural plans based more heavily on societal preferences and human behavior which are subject to change. Policies and rules established with implementation of any nonstructural flood plain management plan can be changed by Act of Congress or Executive Order, or they can be circumvented by private interests. Still another difficulty is comparing the outputs of nonstructural alternatives with structural alternatives. If the benefits of each alternative, structural and nonstructural, are not of the same order of magnitude, valid comparisons and selection of the best plan are formidable tasks.

Study Area and Without Project Conditions

The study area is bound on the west by levees A, B, C, and D on the South Sulphur and Middle Sulphur Rivers near Commerce, Texas. The area extends east along the South Sulphur River and the Sulphur River within the standard project flood plain to the headwaters of Wright Patman Lake (see figure 7). The flood plain is relatively flat and wide with steep side slopes. For this reason, the various frequency flood outlines are similar except where existing levees and channels have limited effectiveness. There are very few structures in the flood plain. The predominant soil types are Kaufman clay and Trinity clay. Historically, flooding is most severe during the late fall, winter, and spring months.

The two primary categories of damage resulting from flooding are agricultural and nonagricultural. Agricultural flood damages under 1974 conditions are mainly attributed to lost grazing of cattle on pasture land during flood conditions. Nonagriculture damages occur to fences, farm equipment, structures, levees, roads, and bridges. Under the status quo condition for the 30-year flood plain (Hagansport gage at stage 49.1), 12,300 acres of semiwooded land and 18,900 acres of cleared land are subject to damages. An additional 58,000 acres of wooded land are subject to flooding. Agricultural damages were computed only on cleared and semi-wooded acreages while nonagricultural damages occur on all three land use categories. The computation of agricultural and nonagricultural damages is taken from Cooper Lake Design Memorandum No. 2-B, Revised, Supplement No. 1, approved 11 August 1977, and supporting documents. These damages are described in detail in appendix C to the supplemental EIS.

a. Agricultural Damages. For 1974 conditions, agricultural land utilization in the Sulphur River Basin is devoted almost exclusively to grazing. Two basic types of cattle operations are involved in the study area. These are cow-calf enterprises and stocker-calf enterprises. Typical land utilization for pasture within the Sulphur River bottom in 1974 involved approximately 20 percent under advanced management and 80 percent under average management with 30 percent of each category in stocker-calf enterprises and 70 percent in cow-calf enterprises. Accordingly, the estimated weighted gross economic return per acre is $87.72.

The above weighted gross average return of $87.72 per acre represents the economic potential of Sulphur River bottomland when utilized for cattle production under 1974 conditions considering no flood damages occur. In evaluating the damages associated with flooding, the procedure adopted was to ascertain the extent of damage that would have occurred under a 27-year historic flood series to the area in pasture and semiwooded land uses. Damage estimates were developed based on pasture damage curves for an alluvial valley prepared in 1958 by the US Army Corps of Engineers which expressed damage due to inaccessibility and to stand, by season of year and duration of flooding, as a percent of gross profit. The production loss per acre is expressed in dollars and is arrived at by multiplying the total percent of loss by the $87.72 average potential profit per acre. The rationale involved is that the potential profit gained from the cattle operations is directly dependent on the utilization of pasture. Since the economic return from use of the pastureland is realized through the marketing of beef, a fair measure of value of this pasture was determined based on the potential gain of weight to the cattle involved. A reasonable measure of flood damages is reflected in the reduction in weight gain the cattle would experience if not sustained during flooding by supplementary feeding. Exhibit 5 of appendix C lists the potential agricultural damages for cattle production based on historical flood records and 1974 conditions.

b. Nonagricultural Damages. In an effort to arrive at a fair basis for evaluating nonagricultural damage, consideration was given to the damage surveys by the US Army Corps of Engineers relative to the floods of October to December 1971. While these surveys covered a wider area than that under immediate consideration, they did set forth specific figures relative to the South Sulphur River and the Sulphur River. Damages in this area have been updated to July 1974 prices and are presented in the following tabulation.

Item	South Sulphur River	Sulphur River
Fences	$496,000	$ 527,500
Roads and bridges	21,800	22,900
Levees	306,000	618,800
Other	12,400	
Totals	$836,200	$1,169,200

Nonagricultural damage consisting of $836,200 for the South Sulphur River and $1,169,200 for the Sulphur River below Cooper dam amounts to $2,005,400 for the area inundated by the floods of October to December 1971, totaling 111,900 acres within these two reaches. Thus, the average nonagricultural flood damages per acre inundated is $17.92.

Nonstructural Management Measures Considered in the Final EIS

Four measures, or methods of nonstructural flood damage prevention or flood plain management were discussed in the final EIS. These were flood insurance, flood warning and temporary evacuation, flood

regulation and/or zoning, and flood plain acquisition. The merits and disadvantages of each are described below.

a. Flood Insurance. Flood insurance redistributes the cost of flood losses to a larger area and number of people. Under the National Flood Insurance Program, flood insurance is currently not available for crops and livestock. The Sulphur River flood plain is predominately agricultural with little structural development existing or foreseen in the future. For this reason, flood insurance alone would not serve as a viable solution for the Sulphur River flood plain.

b. Flood Warning and Evacuation. Flood warning and evacuation was addressed in the final EIS as a method which could be used to allow the removal of some farm equipment, supplies, and livestock from the flood plain in the event of a forecast of eminent flooding. Floods resulting from thunderstorms give little time for evacuation of farm equipment, supplies, and livestock from remote areas. Other damageable property in the flood plain (bridges, fences, roads, farm structures) could not be moved and would continue to suffer damage.

c. Zoning. Another nonstructural measure considered was flood plain regulation and/or zoning. Under this plan, the responsibility for implementation of zoning regulations would lie with the State or local governments for purposes of participating in the National Flood Insurance Program. Coupled with flood insurance, zoning is an effective means of encouraging long-term reduction in flood damages while compensating flood victims in the short term. The existing development and foreseeable development in the Sulphur River flood plain is predominantly agricultural. While the buildings associated with agricultural activities are eligible for flood insurance, the crops, livestock, and other farm products which make up the bulk of the damageable investment in the flood plain are not themselves eligible for insurance under this program. Additionally, no new habitable structures are projected under the without project condition, and no benefits have been claimed for flood damages to future structures within the 100-year flood plain in evaluating structural flood damage reduction measures. Flood plain zoning was addressed as an effective means of reducing encroachment of any developments into the flood plain. However, this measure would not reduce flood damages resulting from existing agricultural practices or damageable property in the flood plain.

d. Flood Plain Acquisition. The remaining management measure, flood plain acquisition, was addressed in the final EIS as an alternative for purchase and removal of damageable property from the 30-year flood plain, a restrictive easement to protect the existing flood plain from further damage (in effect, a land use easement) and removal of damageable property, and a nonrestrictive easement which would pay the private owners a one-time fee for compensation of any damages to their life, health, and property as a result of natural flooding. Benefits and costs of the fee purchase alternative were displayed in table VI-3 of the final EIS. First cost and annual charges only were displayed for the restrictive and nonrestrictive easement alternatives. No benefits (and no benefit/cost ratio) were

claimed since the land would remain in private ownership, and there would be no change in use from the status quo condition. No benefits were claimed for flood damage reduction, since damageable property would be removed (or compensated for) as a first cost of the alternative. These three nonstructural alternatives involving acquisition were also evaluated in combination with reservoir construction under the structural alternatives in order to provide plans meeting both water supply and flood control project purposes.

A major problem with any form of degree of flood plain for acquisition as an implementable alternative for agricultural flood damage reduction in the Sulphur River Basin is that much of the damageable (cleared and semiwooded) pastureland now receives some protection from annual flooding either through past levee and channel protection or by its general position in flood plain in relation to flooding frequency. This protection is, however, less than the level authorized by Congress for the structural Cooper Lake and Channels project. Acquisition of nondamageable agricultural property, i.e., the wooded areas, would result in a reduction only in average annual damages to fences and limited farm equipment or buildings. While Federal fee acquisition of wooded areas can result in a substantial public benefit through increase in public recreational use, damage reduction benefits are few. In addition, only if the wooded areas are expected to be cleared without any Federal action do benefits accrue for fish and wildlife preservation, water quality maintenance, natural flood storage, aquifer recharge, or other natural or beneficial flood plain values of wooded areas. Additionally, fee acquisition should also consider the social impacts and tradeoffs involved in any taking of private land for public purposes.

Development of a Comprehensive Nonstructural Flood Damage Reduction Plan

None of the nonstructural measures discussed in the final EIS can individually economically reduce flood damages in the Sulphur River flood plain. Rather, the nonstructural measures must be integrated to provide a viable plan. As noted, existing land use of the Sulphur River flood plain is predominantly agricultural with practically no additional structural development forecast for the foreseeable future, and since damages to existing structures or facilities in the flood plain constitute only a small portion of the existing average annual damages, any approach to comprehensive nonstructural flood plain management for the entire 30-year flood plain as a viable alternative must be based primarily on implementing those societal preferences for restoring and preserving natural and beneficial flood plain values. These preferences are expressed as concepts in the Water Resources Development Act of 1974. Executive Order 11988 on Flood Plain Management, the Water Resources Council's Unified National Program for Flood Plain Management (1976), the National Flood Insurance Act of 1968, the Flood Disaster Protection Act of 1973, Principles and Standards for Water Resource Development Planning (1973), the President's Water Policy Initiatives of July 12, 1978, and Corps implementing policy and regulations. The Clean Water Act, EO 11990, and the Chief of Engineers Wetland Policy also relate to the current societal preferences for restoring or preserving natural and beneficial flood plain values.

In order to manage the lands within the Sulphur River flood plain to reduce existing flood damages or accommodate flooding, three approaches may be taken. One of these involves changing the land utilization of part or all of the cleared, semiwooded, and wooded bottomland to uses subject to less economic damage from flooding. Such land uses could be conversion to agricultural products more compatible with the flood hazard and/or to a recreational use such as leasing for hunting or fishing. The second approach would be to floodproof to some degree existing levees, roads, bridges, and houses. A third approach involves combining land use changes and floodproofing measures into an aggregate plan that considered societal preferences, as well as reduces flood damage.

The Fort Worth District was aided in the development of a comprehensive nonstructural flood damage reduction plan by the consulting firm of Sheaffer and Roland, Inc. The firm, in conjunction with district personnel, applied a multidisciplinary approach to developing the concepts for a nonstructural plan. The concepts were then carried forth by the Fort Worth District in the development of a detailed plan.

Recognizing the status quo condition of the Sulphur River flood plain and the future projected for that flood plain in the 1977 Plan Selection Report utilized for the final EIS, one comprehensive nonstructural flood damage reduction plan was formulated from measures considered in the final EIS and new measures considered in the foregoing discussion.

Plan Description

The comprehensive nonstructural flood damage reduction plan consists of future land use restrictions, levee maintenance, flood proofing, and a land use plan which suggests uses for flood plain lands compatible with the flood hazard. Implementation of the land use plan would be contingent upon the voluntary participation of individual landowners. Encouragement to participate would come through public awareness and technical assistance. An incrementally justified recreation plan was also formulated to function in concert with the flood damage reduction aspects of the nonstructural flood damage reduction plan.

a. Flood Damage Reduction. The plan accomplishes flood damage reduction primarily by reducing expenditures for damages to fences and for lost grazing time on pastures during and after flooding. To a lesser extent, expenditures related to the few flood damaged structures are also reduced. The nonstructural measures recommended to achieve flood damage reduction include dividing the flood plain into zones, restricting future structural development, maintaining certain existing levees, and floodproofing residential structures.

(1) Zoning. A key factor of the comprehensive nonstructural flood damage reduction plan is the division of the flood plain into three zones which will promote land uses compatible with the flood

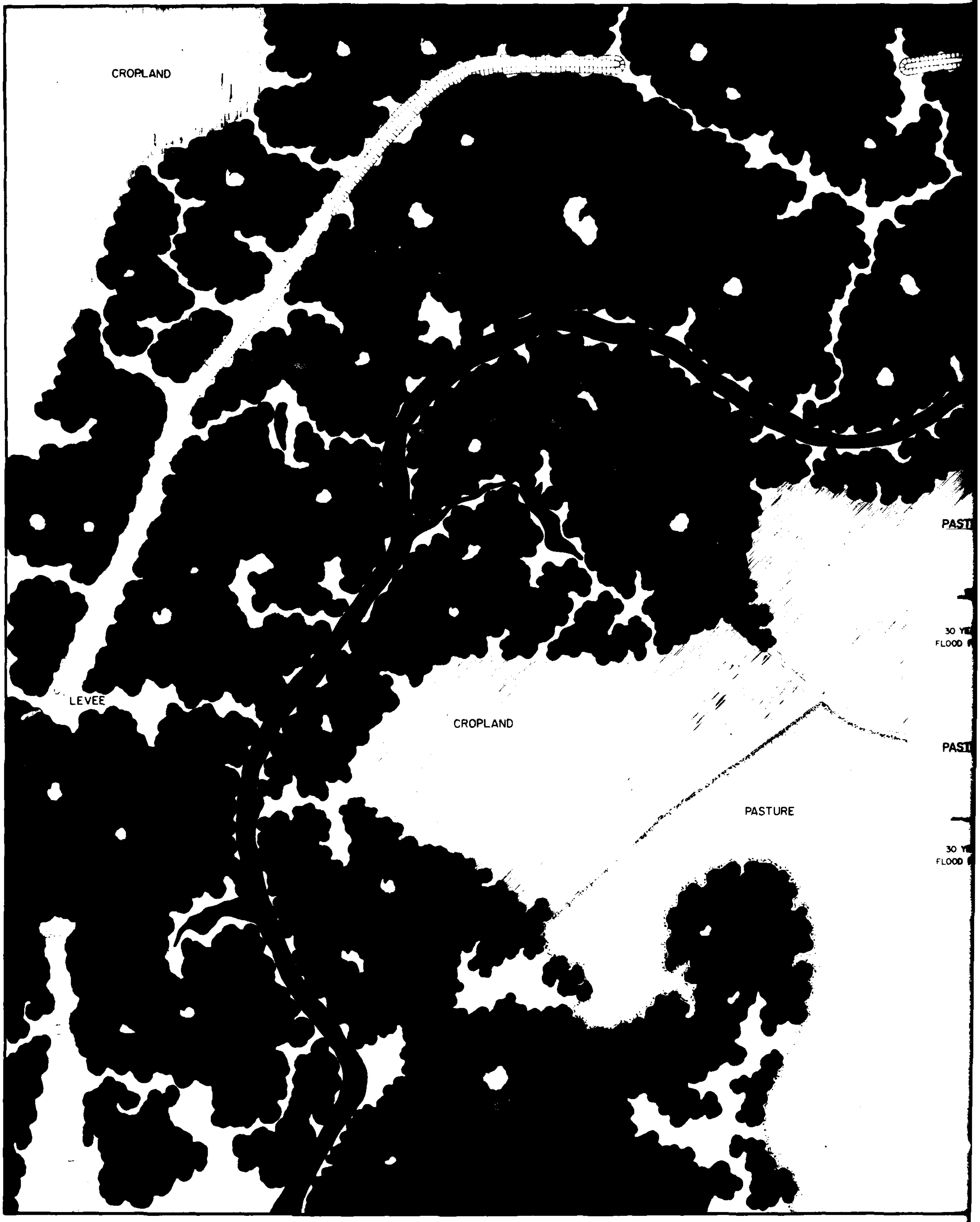
hazard. As mentioned, implementation of the zoning plan will be voluntary. Much of the flood plain is used for agricultural purposes. The National Flood Insurance Program provides insurance for activities associated with agriculture such as farm buildings, etc.; however, the National Flood Insurance Program does not provide insurance for crops. Enabling legislation for flood zoning in the State of Texas is specifically for implementation of the National Flood Insurance Program. Therefore, mandatory zoning is not at this time applicable to crops, and it was decided that the zoning of crops called for in this plan would be voluntary. An alternative would be to seek special legislation enabling counties to zone specific agricultural activities in order to achieve project purposes.

The habitat zone extends on both sides of the river within the 30-year flood plain beginning at State Highway 71 at existing levee D and continues downstream to the headwaters of Wright Patman Lake at IH 30. There are 6,900 acres in this zone upstream of the Cooper damsite and 59,300 acres downstream of damsite for a total of 66,200 acres. Of the 66,200 acres, 24,200 acres are devoted to the recreation corridor, which will be discussed in later paragraphs of this report. The habitat zone will be used for wildlife habitat and as a vegetative filter for the removal of suspended solids and nutrients from stormwater runoff. Selective harvesting of forest products will be encouraged in the habitat zone in order to better control erosion and yield higher profits to foresters. Existing cropland and pastureland will revert to wildlife habitat.

The pastureland zone would consist of the sloping land adjacent to but along the edges of the flood plain on either side of the river. The degree of land slope which defines the extent of the zone in any particular area should relate to the potential for erosion in the area. The 30-year flood outline was chosen as a convenient boundary for this zone because it generally falls along the line of steepened slopes. The pastureland zone should be managed so that erosion is minimized and sound land treatment practices are followed. Grazing, as well as the uses permitted in the habitat zone, should be permitted in this zone.

The cultivated zone would extend over the entire 30-year flood plain with the exception of land in the habitat zone. There are 19,100 acres in the cultivated zone. Cultivation of row crops, as well as all uses permitted in the habitat and pastureland zones, should be permitted in this zone. Uses that restrict the extent of flooding or the streamflow should be regulated in the cultivated zone to keep from inducing additional flooding elsewhere.

Figures 6 and 7 illustrate the zoning concept.


CROPLAND
LEVEE
CROPLAND
PASTURE

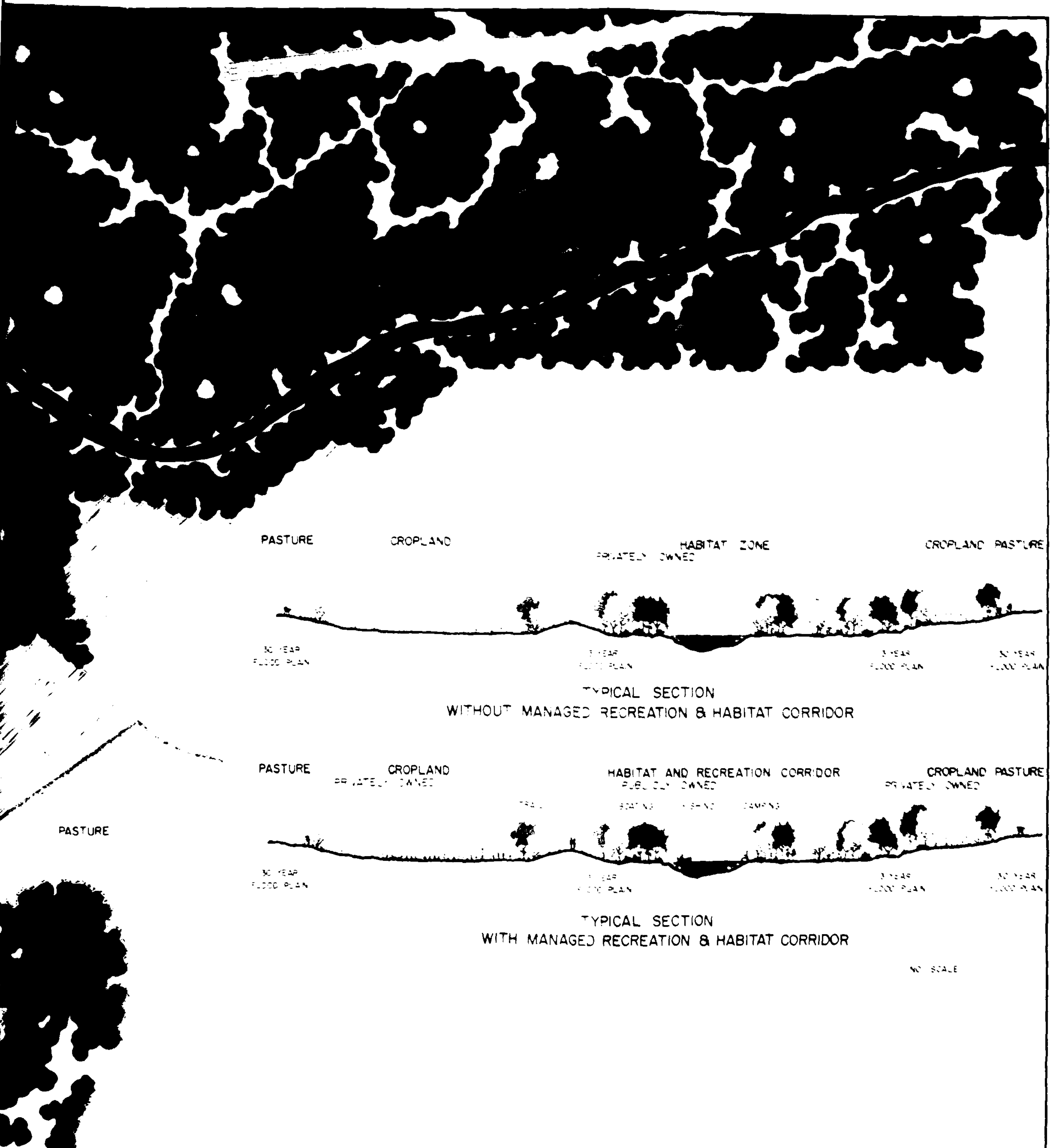


FIGURE 6-ZONING CONCEPTS OF COMPREHENSIVE NONSTRUCTURAL PLAN

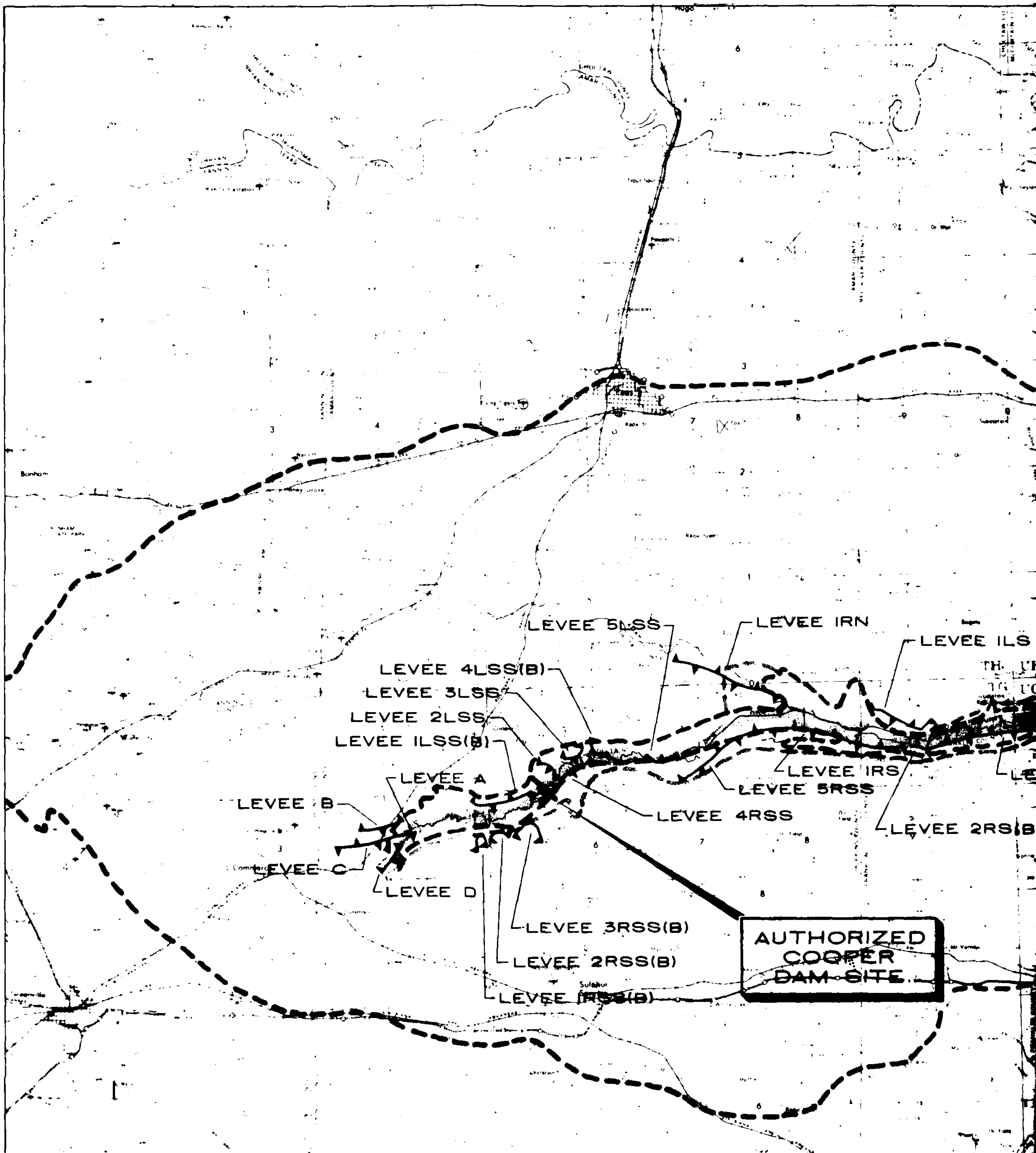
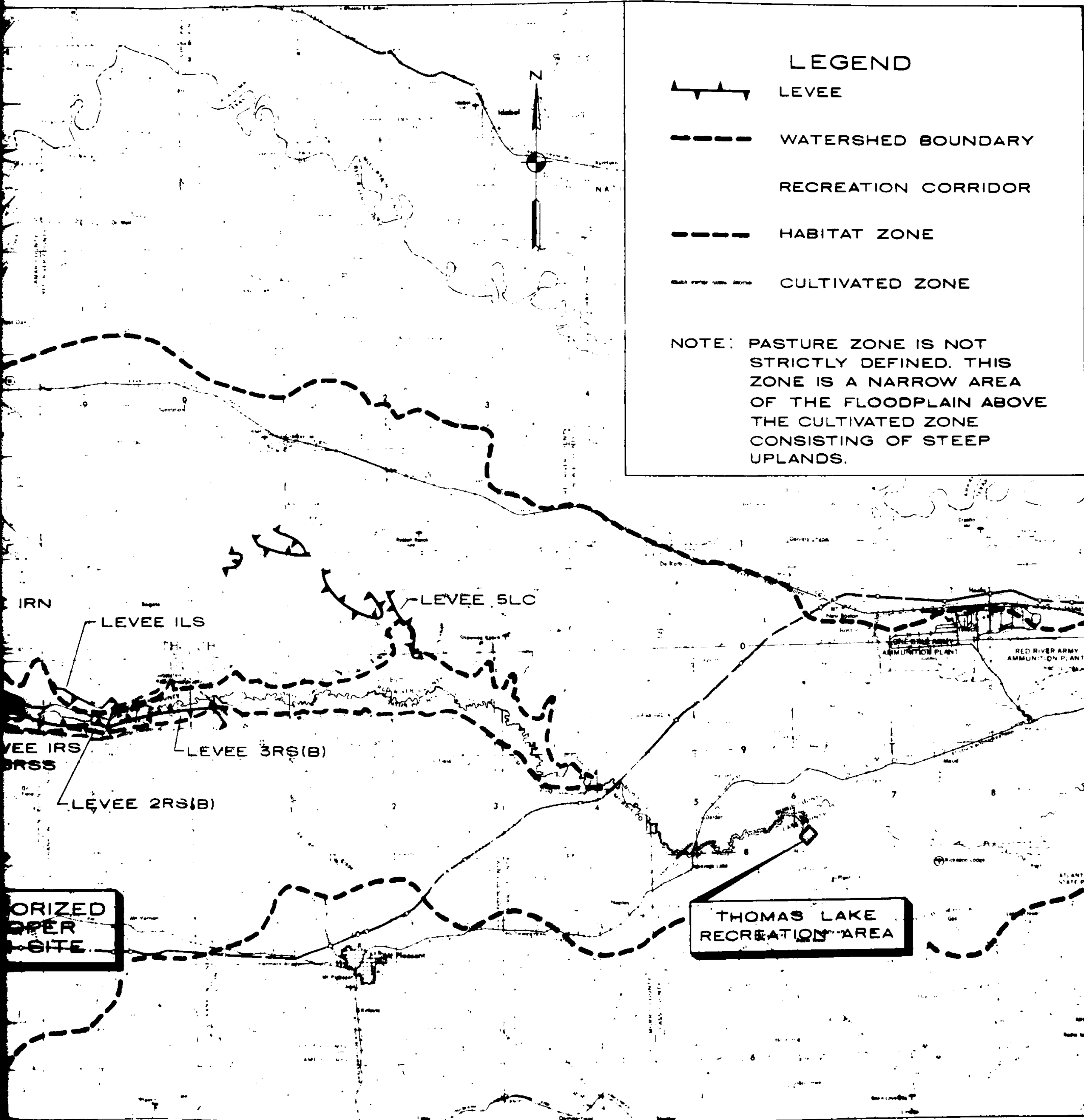


FIGURE 7 - ZONING LIMITS FOR COMPRE



OR COMPREHENSIVE NONSTRUCTURAL PLAN APPENDIX D

(2) Future Development Restrictions. No new structures should be permitted in the cultivated zone unless they are floodproofed to an elevation above the 100-year flood. To achieve this result, all counties would enroll in the National Flood Insurance Program. No structures should be permitted in the habitat zone.

(3) Levee Maintenance. Levee 5RSS must be maintained to provide at least 3-year protection. The responsible entities for this are the Hopkins County Levee Improvement District No. 1 and the Delta County Levee Improvement District No. 1. In addition, levee 1-R-S must be maintained to provide at least 3-year protection. The responsible entities for this levee are the Delta County Levee Improvement District No. 1 and the Franklin County Levee Improvement District No. 1.

(4) Floodproofing. Two houses on State Highway 37 are to be floodproofed to an elevation at least equal to that of the 100-year flood. Damageable equipment should be moved to areas outside the flood plain which, in most instances, is in close proximity to existing equipment sheds.

(5) Technical Assistance. Technical assistance to implement the plan would be available through both existing agricultural agencies located in the study area such as the Soil Conservation Service and the Texas A&M Agricultural Extension Service as well as the Corps of Engineers.

b. Recreation. As discussed, a recreation feature is formulated to integrate with the flood damage reduction aspects of the nonstructural plan in order to satisfy an additional project purpose. A corridor has been outlined from State Highway 71 at existing levee D along the river to Thomas Lake Recreation Area at Wright Patman Lake. The corridor is approximately one-half mile in width, contains most of the river channel meanders and encompasses approximately 24,200 acres. Lands in the corridor would be purchased in fee. The corridor features a trail system and several pocket parks along the way. Additionally, there would be more intense management of the wildlife habitat in this area.

Benefit-Cost Analysis

The future without project condition is the benchmark for the development of benefits for the comprehensive nonstructural flood plain management plan. The benefits and costs that would accrue to the comprehensive nonstructural plan are based on the assumption that the plan would be implemented by the Federal government with voluntary implementation by landowners of the agricultural zoning feature. The various categories of benefits that result from adoption of this plan are described below.

a. Agricultural Intensification.

(1) General. A major factor in the evaluation of the nonstructural plan is the availability of crops that are compatible with conditions in the Sulphur River flood plain. The recommendations offered are based on a study of the soil survey reports for the affected counties published by the USDA Soil Conservation Service and telephone interviews with individuals versed in agricultural practices in Texas. It was found that no cultivated crops other than certain species of trees should be grown inside the 3-year flood plain. The major problems encountered with growing crops inside the 3-year flood plain are the depths of flooding and the long duration of standing water, which result in drowning the crops at the seedling stage and producing muddy conditions during harvest. For this reason, the plan incorporates only natural flood plain vegetation inside the 3-year flood plain. The most promising crops for production in the area between the 3-year flood plain and the 30-year flood plain were found to be improved pasture planted in coastal hay, green ash, and cottonwood tree production in the existing wooded areas. Cotton and soybeans are also desirable crops for the area, but are less lucrative than improved pasture and timber production when flood damages are considered. Other crops considered included sugar cane, rice, and small grains. However, it was found that for various reasons these crops were not as profitable or adaptable to this region as the aforementioned crops. Table 26 reflects estimated profits excluding flood damages for various crops.

The Texas A&M Agricultural Extension Service has farm management agents in each county who are available for further assistance to landowners. Additionally, the Soil Conservation Service has personnel available to provide technical assistance to landowners.

There are three conditions in which more intensive land uses in the cultivated zone may occur. They are: conversion of wooded land to more economically attractive crops, conversion of semiwooded land to more economically attractive crops, and conversion of existing cleared land (pasture and cultivated) to more economically attractive crops. Key factors that must be given consideration in determining the potential economic gains to farmers that would take advantage of agricultural intensification are:

- Potential yields of the proposed crops in the Sulphur River flood plain.

- Market for the proposed crops - now and potential if there is substantial production of them in the area.

- The land available for intensification in the flood plain above the 3-year flood outline.

- The future flood damages that will occur - using past inundation data as well as information found in crop research.

TABLE 26

ESTIMATED PROFITS FOR VARIOUS CROPS CONSIDERED

Crop	Management Level	Estimated Profit Per Acre for 1974 1/
Hay Production	High	$ 45.23
Hay Production	Typical	22.61
Timber Production (wooded conversion)		12.69
Soybeans	High	32.39
Soybeans	Typical	17.45
Oats	High	-16.21
Oats	Typical	-25.84
Cotton (lint & seed)	High	-5.18
Cotton (lint & seed)	Typical	-34.13
Grain Sorghum	High	-53.27
Grain Sorghum	Typical	-61.90
Wheat	High	1.31
Wheat	Typical	-10.91
Cow-calf/stocker-calf 2/		38.38

1/ Flood damages are not reflected in profit figures.

2/ Representative of agricultural practices existing in the study area in 1974.

Considering the above, the following assumptions were made:

- The 66,200 acres inside the 3-year flood plain known as the habitat zone will remain unchanged, with the exception that any cropland or pastureland will revert to natural habitat.

- The 3,200 acres in the cultivated zone that is currently wooded will be harvested and converted to managed forest production.

- Eighty percent or 2,400 acres of the existing 3,000 acres of semiwooded land in the cultivated zone will be cleared and utilized for new crop production. The remaining 600 acres will remain in cattle production.

- Eighty percent or 10,300 acres of the 12,900 acres of cleared land in the cultivated zone will be converted to new crop production. The 2,600 acres of cleared land remaining will remain in cattle production.

A summary of projected land uses with and without the recommended comprehensive plan is shown in table 27.

TABLE 27

LAND USES WITH AND WITHOUT THE NONSTRUCTURAL PROJECT (ACRES)

Area	Cleared	Semiwooded	Wooded	Total
Without the Nonstructural Project				
Habitat Zone	3,300	6,600	56,300	66,200
(cattle)	(3,300)	(6,600)	(0)	(9,900)
(habitat)	(0)	(0)	(56,300)	(56,300)
Cultivated Zone	12,900	3,000	3,200	19,100
(cattle)	(12,900)	(3,000)	(0)	(15,900)
(habitat)	(0)	(0)	(3,200)	(3,200)
With the Nonstructural Project 1/				
Habitat Zone	0	0	66,200	66,200
(habitat)	(0)	(0)	(66,200)	(66,200)
Cultivated Zone	15,300	600	3,200	19,100
(cattle)	(2,600)	(600)	(0)	(3,200)
(habitat)	(0)	(0)	(0)	(0)
(timber production)	(0)	(0)	(3,200)	(3,200)
(hay production)	(12,700)	(0)	(0)	(12,700)

1/ The with nonstructural project condition assumes conversion of cleared and semiwooded lands to wooded lands over the life of the project.

(2) Intensification Benefits. The most advantageous new crop to plant in existing semiwooded and cleared areas was found to be improved pasture planted in coastal hay to be used for sale. It is assumed that high management practices will be utilized on the 80 percent (10,300 acres) of cleared land that is converted to improved pasture, and that typical management will result on the 80 percent (2,400 acres) of semiwooded land that is converted to improved pasture. The remaining lands in both cleared and semiwooded areas are assumed to remain in cattle production. A compatible land use for the existing wooded area which would provide an economical return would be conversion to forest products production. The income from forestry production occurs over longer intervals than does hay production in that there are seven harvests over the 100-year project life. There is, however, considerably lower land maintenance. Implementation of the above mentioned assumptions results in a loss in revenues of $513,000 and a benefit to inundation damage reduction of $652,000 due to reduced damages to coastal hay as compared with existing cattle production. Table 28 displays the effects of agricultural intensification in the cultivated zone. Costs involved with implementation of the agricultural portion of this plan include $8,100 annually for clearing of semiwooded lands that are converted for hay production. This is based on a cost of $100 per acre for clearing the 2,400 acres semiwooded lands. Additionally, there would be an annual charge of $50,000 for technical assistance.

The without project condition assumes existing levees along the Sulphur and South Sulphur Rivers would deteriorate in time from a lack of maintenance since their designed level of protection could not be achieved without flood control storage in Cooper Lake. Therefore, in order to insure that 3-year protection continues to be provided in the area behind levees 5RSS and 1RS, a cost was assigned for levee maintenance. The annual cost for this function is $18,900 (based on average annual maintenance cost of $1,200 per mile).

b. Agricultural Damage Reduction. These benefits are incorporated into the methodology for agricultural intensification, mentioned above. Again, they amount to $652,000 due to reduced damages to coastal hay as compared with damages resulting with cattle production.

c. Nonagricultural Damage Reduction.

(1) Fences. Implementation of the zoning portion of the comprehensive nonstructural plan will cause a reduction of fence damages from floating debris since there would be less clearing and stockpiling of trees within the habitat zone. Clearing and stockpiling would occur within the cultivated zone where flooding is less frequent with smaller depths and velocities than in the habitat zone. Additionally, all cattle in the habitat zone and most cattle in the cultivated zone would be removed. The evacuation of cattle will result in some fences being abandoned rather than being repaired or replaced. The need for fences on land utilized for cultivated crops or timber is reduced to boundary demarcation in the absence of roads and water courses.

TABLE 28
AGRICULTURAL INTENSIFICATION
(1974 price level)

Without Nonstructural Project (31,200 Acres) 1/

Profit Before Flooding

Cattle production (31,200 acres) x ($38.38/acre)	= $1,197,000

Flood Damages

Cattle production (31,200 acres) x ($30.94/acre)	= $ 956,000

With Nonstructural Project 2/

Profit Before Flooding (19,100 acres) 2/

Cleared land hay high mgmt (10,300 ac) x ($45.23/ac)	= $ 466,000
Cleared land cattle production (2,600 ac) x ($38.38/ac)	= 100,000
Semiwooded land hay typical mgmt (2,400 ac) x ($22.61/ac)	= 54,000
Semiwooded land cattle production (600 ac) x ($38.38/ac)	= 23,000
Wooded land timber production (3,200 ac) x ($12.69/ac)	= 41,000
	$ 684,000

Flood Damages

Cleared land hay high mgmt (10,300 ac) x ($17.99/ac)	= $ 185,000
Cleared land cattle production (2,600 ac) x ($30.94/ac)	= 80,000
Semiwooded land hay typical mgmt (2,400 ac) x ($12.02/ac)	= 29,000
Semiwooded land cattle production (600 ac) x ($30.94/ac)	= 19,000
Wooded land timber production (3,200 ac) x ($0.00/ac)	= -0-
	$ 313,000

SUMMARY

	Profit Before Flood Damages	Flood Damages	Net Difference
Without Project	$1,197,000	$965,000	$232,000
With Project	684,000	313,000	371,000
Change	$ 513,000	$652,000	$139,000

1/ The without nonstructural project condition assumes use of lands in the habitat and cultivated zones (river to 30-year flood plain).

2/ The with nonstructural project condition assumes use of lands in the cultivated zone (3-year to 30-year flood plain).

Because of limited specific data on the extent of flood damages to fences in the Sulphur River flood plain, estimates of benefits and costs associated with reduction of these damages must be based on somewhat arbitrary, yet reasonable, assumptions. It was determined that implementation of the plan could result in damage reduction to fences of 20 percent, for an average annual fence damage reduction benefit of $43,900. Based on a cost of $0.50 per foot for removal of fences and the 20 percent of available fences being removed, the annual charge for removing fences would be $4,400.

(2) Other Structures. An onsite field investigation coupled by a review of recent aerial photographs revealed two small frame houses and seven small farm structures (hay barns, etc.) located within the 100-year flood plain. Values of these structures and their contents were estimated and correspondingly damages were computed.

Both houses are located on State Highway 37. Together the houses and their contents have an estimated value of $24,300. It is estimated that these two residences (including contents) experience damages averaging $200 annually. Floodproofing would involve raising the foundations of both houses three feet above their present elevation for a combined annual charge of $200.

The seven farm structures as a group have an aggregate value of $33,000 and incur about $200 annual damages. These structures are not habitable and most appear to have been in the flood plain for a number of years. Additionally, the structures are within a couple feet of the 100-year flood plain. Due to the fact there is no potential for loss of life and because of the relatively low annual flood damages experienced, it is uneconomical to floodproof these buildings. Owners of these farm buildings should be made aware of the potential flood threat and, if possible, identify alternate uses for these buildings which would be compatible for the flood hazard.

Table 29 provides a summary of costs and damages associated with floodproofing the structures. Costs for floodproofing are based on data presented in the manual Physical and Economic Feasibility of Nonstructural Flood Plain Management Measures, published by the Hydrologic Engineering Center and Institute for Water Resources. Average annual damages were computed by the Fort Worth District using representative damage functions for the various structures.

d. Fish and Wildlife. Fish and wildlife benefits are expected to accrue primarily in the habitat zone. Regrowth of the understory and diversification of vegetative species that will accompany the restrictions of grazing should improve the habitat quality considerably. This results in monetary average annual benefits of $29,300 for sport hunting and $2,400 for trapping.

TABLE 29

FLOODPROOFING SUMMARY
(1974 Price Level)

Structures	Value Structure, Contents, Equipment	Total First Cost to Floodproof	Average Annual Cost to Floodproof	Average Annual Damages
2 Residential * Units	$24,300	$5,900	$200	$200
7 Barns	$33,000	N/A	N/A	$200

* NOTE: Substandard houses must be brought up to standard conditions.

e. Recreation. The recreation feature of the nonstructural plan calls for purchase of a corridor one-half mile in width beginning at existing levee D near State Highway 71 and proceeding downstream along the river to Thomas Lake Recreation Area at the headwaters of Wright Patman Lake.

The Texas Parks and Wildlife Department (TPWD) in its Texas Trailways report points out that opportunities for dispersed-type recreational activities such as biking, backpacking, bicycling, horseback riding, nature study, and primitive camping in natural settings close to home are rare and unusual occurrences, and that flood plains have excellent potential for trail development. The Texas Trailways report also indicates that the Arkansas-Texas Council of Governments has proposed a trail system which would connect Cooper Lake and its recreational facilities with facilities at Wright Patman Lake.

According to the Texas Outdoor Recreation Plan (TORP), a number of problems exist with regard to providing adequate hunting opportunities in Texas. The foremost of these problems is lack of access to private lands suitable for hunting. Other problems are high cost, restrictive leasing practices of private landowners, crowded conditions on public hunting lands, less than optimum distribution of wildlife and lands available for hunting, low harvest rates, and the critical loss of high quality wildlife habitat from competing land uses. The alleviation of these problems would make the most effective contributions toward providing more adequate hunting opportunities for Texas. Adoption of this alternative would help to alleviate these problems.

Implementation of this plan would also help to meet the need for the preservation of natural areas for open space and fish and wildlife management which is becoming increasingly apparent as more existing areas are encroached upon by commercial or housing developments and more intensified land use.

Recreational development of the approximately 24,200 acres would be planned to provide opportunities for both day use and overnight use with facilities to be provided consisting of roads, parking, tables, potable water, sanitary facilities, and trails. The proposed use and facilities will complement the natural resources of the area, not destroy them.

People today more than ever before need areas of solitude where they can get away from the hustle and bustle of everyday life and enjoy outdoor recreational activities such as hiking, bird watching, photography, nature study, and primitive camping. These types of activities can best be experienced in areas receiving relatively light use, and the people participating in these activities will receive a higher quality recreation experience because of the less crowded conditions.

The TORP identifies many of the types of facilities that are associated with or could be provided in conjunction with this plan. These facility needs include camp and picnic units, boat ramps, trails, canoeing and river type fishing.

Access will be provided to this area in nine places. These are the South Sulphur Access Area, at the Cooper Dam, State Highway 154, Farm to Market Road 69, State Highway 37, U.S. Highway 271, Harts Bluff Community (approximately river mile 150), Interstate Highway 30, U.S. Highway 67, and the existing Thomas Lake Park on Wright Patman Lake.

The concept for recreational development of these approximately 24,200 acres of land envisions the development of an extensive multiple use trail system starting from the park and access areas and proceeding into scenic areas. Interpretation will be made at intervals along the trails and will include self-guiding nature trails providing access to scenic natural areas and wildlife interpretive areas. Provisions will be made for nondeveloped camping areas along the trail, and developed camping and picnic facilities will be provided in developed park areas adjacent to the access areas. The final location of these facilities will be determined in the field.

The park adjacent to highway crossings will receive high use. These areas will be intensively developed and will give primary emphasis to providing sufficient recreation facilities for the continued enjoyment and maximum sustained use by the visiting public, consistent with the carrying capacity and esthetic and biological values. This requires a balanced approach to facility development which must take into consideration both the recreational and environmental goals in order to achieve an equilibrium between conservation of the natural environment and development for public use. These areas will have a mix of day use and overnight facilities. Campsites will be multiuse and will be designed for visitors with travel trailers, popup trailers, campers on pickups, or tent camps.

Each site will consist of a parking area of sufficient dimensions to accommodate an automobile with a typical recreational trailer in tow. Adjacent to parking areas will be campsites. The campsites will consist of a table with benches, an electrical outlet, a water faucet, a trash receptacle, and a cooking grill. Picnic units will consist of a parking area, a table with benches, a trash receptacle, and a cooking grill. Waterborne toilets, camper service buildings, and potable water will also be provided.

Areas along the trails will be developed for low density use and will be designed to protect, maintain, and enhance existing environmental and recreational values. The primary objective will be to provide opportunities for outdoor recreation activities such as hiking, bird watching, nature study, photography, natural environment camping, and other recreation activities which require limited development and which will leave the area natural in appearance.

Land requirements for park development are based on the optimum recreational facility development with allowances for undevelopable park land area to serve as buffer area, green space, and preservation of the park-like atmosphere to assure the enhancement of the recreational experience. Participation rates are combined with space standards and associated planning decisions to derive the most accurate estimate of land requirements for the project. The final result is the gross acreage requirement necessary to accommodate the design day load. The acreage is used as a basis for choosing the size and number of public use land parcels to be required and developed. The land requirements thus determined are shown in table 30.

TABLE 30

RECREATION LAND REQUIREMENTS

Area	Acres
South Sulphur Park	100
State Highway 154 Park	25
Farm to Market Road 69 Park	50
State Highway 37 Park	200
U.S. Highway 271 Park	1,000
Harts Bluff Community Park	50
Interstate Highway 30 Park	1,000
U.S. Highway 67 Park	200
Total	2,625

This 2,625 acres will be developed for intensive recreational use. The remaining 21,575 acres will be utilized for low density recreational uses.

Management of the area will be designed to protect, maintain, and enhance existing environmental and recreational values. The primary objective will be to provide opportunities for outdoor recreation activities such as hiking, bird watching, nature study, photography, and primitive camping. To achieve this objective, it will be necessary to take the following action.

(1) All camping areas will be sited in the field by district and project personnel. Attention will be focused on the proper distribution and use of the area to protect the natural resources and to enhance the recreational experience.

(2) A carrying capacity will be determined and implemented for each primitive camping area. The carrying capacity is the ability of a site to absorb outside influence and still retain its quality.

(3) The "fallow campground" concept, which requires camping areas to be rested from use periodically, will be employed.

(4) Simple comfort stations will be provided for recreation users. These toilets will be designed and located so that they are in harmony with their surroundings.

(5) Motorized land travel, except that required by project personnel to protect and maintain the parks, will be prohibited.

The methodology use for predicting recreation use follows the instructions presented in ER 1120-2-403. Using this methodology, the total unsatisfied recreation needs for the market area were determined and are computed in table 31.

TABLE 31

UNSATISFIED RECREATION NEEDS

Decade	Need
1985	1,287,956
1990	1,486,923
2000	1,872,435
2010	2,138,034
2020	2,686,139
2030	3,085,268

The plan will accommodate a total use of 613,000 recreation days annually. This figure takes into account existing recreational opportunities of the general market area in which they are located. Table 32 depicts the recreational use by area.

TABLE 32

RECREATION USE

(Expressed in Recreation Days)

Area	Recreational Use
South Sulphur Park	20,000
State Highway 154 Park	12,000
Farm to Market Road 69 Park	12,000
State Highway 37 Park	38,000
U.S. Highway 270 Park	200,000
Harts Bluff Community Park	10,000
Interstate Highway 30 Park	200,000
U.S. Highway 67 Park	38,000
Subtotal (General Recreation)	530,000
Sport Fishing (Existing Stream Potential)	17,000
Sport Hunting (Existing Potential Plus Increase Due to Habitat Zone)	66,000
Total	613,000

Staff of the Texas Parks and Wildlife Department in Austin, Texas, were contacted by phone to determine if the State would be interested in cost sharing as well as performing operations and maintenance functions in conjunction with the above mentioned plan. Staff personnel contacted indicated no interest. Nevertheless, the recreational aspect of the nonstructural plan is incrementally justified and could be implemented at some point in time by the State or other responsible agency. For this reason, the recreation aspects of the plan will constitute an integral part of the comprehensive nonstructural flood damage reduction plan.

The recreation cost presented in this plan is based on July 1974 price levels and an interest rate of 3-1/4 percent. A summary of the recreation cost is shown in table 33.

The recreation benefits expected to result from the development of recreation facilities associated with the plan were developed by assigning unit values to the expected average annual recreation use. The unit values for the various activities are based on criteria established in Supplement No. 1 to Senate Document 79. The average annual equivalent recreation use is shown in table 34.

TABLE 33

RECREATION COSTS

Recreation Costs	
Lands and Damages	
Lands (24,200 acres x $175/acre)	$4,235,000
Damages and Contingencies	1,821,000
Administrative (1.3% of lands, damages, & contingencies)	79,000
Subtotal	$6,135,000
Facilities (613,000 user days x $4.00)	$2,452,000
Contingencies ± 25% Facilities	613,000
Engineering and Design (9.5% of facilities & contingencies)	291,000
Supervision and Administration (8.7% of facilities & contingencies)	267,000
Subtotal	$3,623,000
Interest During Construction (0.0325)	$ 118,000
Subtotal	$3,741,000
Total	$9,876,000
Amortized (100 years at 3-1/4%, average annual cost (0.033884))	$ 335,000
OM&R	
O&M (613,000 user days x $0.30 visitor)	$ 184,000
Replacements (1/3 of facilities every 25 years)	
1,208,000 x .44952 25 years = 543,000	
1,208,000 x .20207 50 years = 244,000	
1,208,000 x .09083 75 years = 110,000	
$897,000	
Average annual cost $897,000 x .033884	$ 30,000
OM&R	$ 214,000
Summary of Annual Costs:	
Lands, Damages, and Facilities	$ 335,000
OM&R	$ 214,000
Total Annual Costs	$ 549,000

TABLE 34

RECREATION AND FISH AND WILDLIFE AVERAGE
ANNUAL EQUIVALENT MANDAYS
NONSTRUCTURAL

Activity	Without 1/ Project	With Project	Gain or Loss
General Recreation	0	530,000	+ 530,000
Sport Fishing			
Stream	17,297	17,297	0
Sport Hunting			
Deer	7,053	8,495	+ 1,442
Raccoon	3,235	4,786	+ 1,551
Rabbit	6,547	7,307	+ 760
Quail	609	419	- 190
Squirrel	34,532	42,480	+ 7,948
Dove	191	106	- 85
Coyote	1,268	1,571	+ 303
Fox	627	654	+ 27

1/ Existing hunting and stream fishing potential within 30-year flood plain

The general recreation benefits expected to result from the development of public use facilities are based upon projected initial recreational use and day use unit values for the activities. The initial and future fish and wildlife benefits were converted to average annual values based on an interest rate of 3-1/4 percent with a 100-year project life (1990-2089). The total average annual fish and wildlife benefits consists of the initial benefit plus the discounted future benefits. Table 35 summarizes the unit values used to compute the recreation benefits. A summary of the average annual equivalent values is presented in table 36.

TABLE 35

UNIT VALUES

Activity	Value
General Recreation	$1.50
Stream Fishing	1.50
Lake Fishing	1.50
Deer Hunting	6.00
Raccoon Hunting	2.00
Rabbit Hunting	2.00
Quail Hunting	2.00
Squirrel Hunting	2.00
Dove Hunting	2.00
Coyote Hunting	2.00
Fox Hunting	2.00

Summary of Benefits and Costs

Table 37 lists the project first costs as well as average annual charges and average annual benefits for the nonstructural project at July 1974 price levels.

Combination Water Supply and Nonstructural Plan

A plan which combines a water supply reservoir with a nonstructural approach to flood damage reduction downstream of the damsite was also considered in plan formulation.

a. Water Supply Aspects of the Plan. A much needed source of water supply would be provided with implementation of this plan. The reservoir would provide a yield of 109 mgd and serve the Sulphur River Municipal Water District, the North Texas Municipal Water District, and the city of Irving, Texas. The reservoir will inundate approximately 19,300 acres.

Recognizing that any public body of water will attract recreation visitors, the water supply reservoir will provide for the health and safety of these visitors. These facilities will consist of guardrails,

TABLE 36

SUMMARY OF RECREATION AND FISH AND WILDLIFE BENEFITS
AVERAGE ANNUAL EQUIVALENT VALUES - NONSTRUCTURAL PLAN

Activity	Without Project	With Project	Gain or Loss
General Recreation	$ 0	$795,000	$+795,000
Sport Fishing			
Stream	25,945	25,945	0
Sport Hunting			
Deer	42,318	50,970	+8,652
Raccoon	6,470	9,572	+3,102
Rabbit	13,094	14,614	+1,520
Quail	1,218	838	-380
Squirrel	69,064	84,960	+15,896
Dove	382	212	-170
Coyote	2,536	3,142	+606
Fox	1,254	1,308	+54

SUMMARY OF RECREATION BENEFITS

General Recreation	$795,000
Sport Fishing	0
Sport Hunting	29,300
Trapping	2,400

TABLE 37

SUMMARY OF BENEFITS AND COSTS FOR THE COMPREHENSIVE NONSTRUCTURAL PLAN
(July 1974 price level)

First Cost	
Intensification	
Agricultural	
Semiwooded Clearing	$ 240,000
Inundation Damage Reduction	
Nonagricultural and Agricultural	
Fences	129,000
Nonagricultural	
Floodproofing Houses	6,000
Recreation	9,758,000
Total	$10,133,000
Average Annual Charges	
Intensification	
Agricultural	
Levee Maintenance	$ 18,900
Semi-wooded Clearing	8,100
Inundation Damage Reduction	
Nonagricultural	
Fences	4,400
Floodproofing Houses	200
Technical Assistance	50,000
Recreation	
General	549,000
Subtotal	$ 630,600
Average Annual Benefits	
Intensification	
Agricultural gain in revenues	$ - 513,000
Inundation Damage Reduction	
Agricultural - reduced crop damages	652,000
Nonagricultural	
Fences	43,900
Floodproofing Houses	200
Recreation	
General	795,000
Sport Fishing	0
Sport Hunting	29,300
Trapping	2,400
Subtotal	$ 1,009,800
Benefits/Costs $1,009,800/$630,600	1.60
Excess Benefits	$ 379,200

turnarounds, and frame toilets at five locations. Additionally, the public would have access to two boat ramps which would be provided primarily for proper management of project lands and waters. A detailed breakdown of the recreation benefits and costs for the water supply aspect of this plan can be found in Section III of this appendix.

b. Nonstructural Aspects. The nonstructural plan in combination with the water supply reservoir deviates little from the comprehensive nonstructural plan earlier discussed. For all practical purposes, there are only four changes that take place. The changes are primarily due to the fact that the nonstructural elements of the plan are in force only downstream of the damsite which reduces the area in which the nonstructural plan is effective.

The first change involves a minor lessening of intensification benefits as a result of fewer lands in which the nonstructural plan is effective. Tables 38 and 39 illustrate this point.

The second change deals with a reduction in the benefits and costs for inundation damage reduction under the category of fences. Again, this change is a result of less land in the area in which the nonstructural plan is in effect. The annual benefits resulting from fence removal are $34,800 and the annual cost is $3,600. The first cost for fence removal under this plan is $105,900.

The third change also results from less land being available in the nonstructural plan for intensification purposes. One thousand acres of semiwooded land will be cleared with the nonstructural aspect of the plan. The project first cost for this action will be $100,000 and the average annual cost is $3,400.

The fourth change results from the addition of a water supply reservoir to the nonstructural plan and its effects on recreation. Basically, the recreation aspects of the combination water supply reservoir and nonstructural plan are the same downstream of the damsite as was discussed in the comprehensive nonstructural plan. The number of acres to be purchased in fee are less (18,300 acres as opposed to 24,200 acres). As a result, the recreation costs for the area downstream of the dam are reduced, see table 40.

Tables 30, 31, 32, 34, 35, and 36 shown in the comprehensive nonstructural plan description of this appendix are generally applicable to the combination plan. Negative sport hunting, sport stream fishing, and trapping losses due to the water supply only plan (table 23, Section III of this appendix) are applied in the overlapping area. The gain in sport hunting and trapping benefits (table 34) would also be adjusted downward slightly to reflect no gains in the overlapping areas. This analysis was not done in detail, but assuming that the change in benefits is approximately proportional to the benefits gained in the 3-year habitat zone, a factor of .9

TABLE 38

COMBINATION WATER SUPPLY RESERVOIR AND NONSTRUCTURAL PLAN

Nonstructural Aspect

Without Project (Downstream of Damsite)

Area	Cleared (acres)	Semiwooded (acres)	Wooded (acres)	Total (acres)
Habitat Zone	3,000	6,000	50,300	59,300
(cattle)	(3,000)	(6,000)	(0)	(9,000)
(habitat)	(0)	(0)	(50,300)	(50,300)
Cultivated Zone	10,800	1,200	3,000	15,000
(cattle)	(10,800)	(1,200)	(0)	(12,000)
(habitat)	(0)	(0)	(3,000)	(3,000)
(hay production)	(0)	(0)	(0)	(0)
(timber production)	(0)	(0)	(0)	(0)

With Project (Downstream of Damsite)

Area	Cleared (acres)	Semiwooded (acres)	Wooded (acres)	Total (acres)
Habitat Zone	0	0	59,300	59,300
(cattle)	(0)	(0)	(0)	(0)
(habitat)	(0)	(0)	(59,300)	(59,300)
Cultivated Zone	11,800	200	3,000	15,000
(cattle)	(2,200)	(200)	(0)	(2,400)
(habitat)	(0)	(0)	(0)	(0)
(hay production)	(9,600)	(0)	(0)	(9,600)
(timber production)	(0)	(0)	(3,000)	(3,000)

TABLE 39

AGRICULTURAL INTENSIFICATION FOR THE NONSTRUCTURAL ASPECT OF THE COMBINATION PLAN

Without Combination Plan (31,200 acres) 1/

Profit Before Flooding

Cattle production (31,200 acres) x ($38.38/acre)	= $1,197,000

Flood Damages

Cattle production (31,200 acres) x ($30.94/acre)	= $ 965,000

With Combination Plan (15,000 acres) 2/

Profit Before Flooding

Cattle production (2,400 acres) x ($38.38/acre)	= $ 92,100
Timber production (3,000 acres) x ($12.69/acre)	= 38,100
Hay production typical mgmt (1,000 acres) x ($22.61/acre)	22,600
Hay production high mgmt (8,600 acres) x ($45.23/acre)	= 389,000
	$ 541,800

Flood Damages

Cattle production (2,400 acres) x ($30.94/acre)	= $ 74,300
Timber production (3,000 acres) x ($0.00/acre)	= -0-
Hay production typical mgt (1,000 acres) x ($12.02/acre)	= 12,000
Hay production high mgt (8,600 acres) x ($17.99/acre)	= 154,700
	$ 241,000

SUMMARY NONSTRUCTURAL ASPECTS

	Profit Before Flood Damages	Flood Damages	Net Profit
Without Project	$1,197.000	$956,000	$232,000
With Project	541,800	241,000	300,800
Change	$ 655,200	$724,000	$ 68,800

1/ The without nonstructural project assumes use of lands in the habitat and cultivated zones (river to 30-year flood plain).

2/ The with project condition assumes use of lands in the cultivated zone downstream of the damsite (3-year to 30-year flood plain).

TABLE 40

RECREATION COSTS
FOR NONSTRUCTURAL ASPECT OF COMBINATION PLAN

Recreation Costs	
Land and Damages	
Lands (18,300 acres x $175/acre)	$3,203,000
Damages and Contingencies	1,377,000
Administrative (1.3% of lands, damages, & contingencies)	60,000
Subtotal	$4,640,000
Facilities (613,000 recreation days x $4.00)	$2,452,000
Contingencies ± 25% Facilities	613,000
Engineering and Design (9.5% of facilities & contingencies)	291,000
Supervision and Administration (8.7% of facilities & contingencies)	267,000
Subtotal	$3,623,000
Interest During Construction (0.0325)	$ 118,000
Subtotal	$3,741,000
Total	$8,381,000
Amortized (100 years at 3-1/4%, average annual cost (0.033884))	$ 284,000
OM&R	
O&M (613,000 recreation days)	$ 184,000
Replacement (1/3 of facilities every 25 years)	
1,207,000 x .44952 25 years = 543,000	
1,208,000 x .20207 50 years = 244,000	
1,208,000 x .09083 75 years = 110,000	
$897,000	
Average annual cost $897,000 x .033884	$ 30,000
OM&R	$ 214,000
Summary of Annual Costs:	
Lands, Damages, and Facilities	$ 284,000
OM&R	$ 214,000
Total Annual Costs	$ 498,000

$(\frac{59,300}{66,200})$ was used to reduce these benefits. This is shown in table 41.

c. Summary of Benefits and Costs. A summary of the project first costs, average annual costs, and average annual benefits are shown in table 41.

d. Plan Implementability. Although the combination water supply and nonstructural plan has a favorable benefit-cost ratio, it was not carried into the final array basically for reasons of implementability. Various parts of the combination plan would need to be carried out by different authorities. In other words, the nonstructural aspects of the plan would require implementation by landowners, counties downstream of the damsite, or levee districts, while the water supply aspects of the project would be implemented by the local water supply sponsors. Although the water supply and nonstructural plan could be considered together, they are in fact two separate plans which compliment each other. Neither the water supply nor the nonstructural plan is fully implementable under current Corps of Engineers authorities.

TABLE 41

SUMMARY OF COSTS AND BENEFITS FOR THE
COMBINATION WATER SUPPLY RESERVOIR AND NONSTRUCTURAL PLAN
(July 1974 Price Level)

PROJECT FIRST COST	
Water Supply Aspect	$ 53,301,000
Nonstructural Aspect	8,474,900
Total	$ 61,775,900
AVERAGE ANNUAL CHARGES	
Water Supply Aspect	
Interest and Amortization	$ 1,923,200
Operation, Maintenance, and Replacements	183,200
Subtotal	$ 2,106,400
Nonstructural Aspect	
Intensification	$ 22,300
Inundation Damage Reduction	3,800
Recreation	498,000
Subtotal	$ 524,100
TOTAL AVERAGE ANNUAL CHARGES	$ 2,630,500
AVERAGE ANNUAL BENEFITS	
Water Supply Aspect	
Flood Control	$ 0
Water Supply	2,671,500
Recreation	136,500
Fish and Wildlife	132,500
Area Redevelopment	208,400
Subtotal	$ 3,148,900
Nonstructural Aspects	
Intensification	$ -655,200
Inundation Damage Reduction	755,200
Recreation	795,000
Fish & Wildlife (.9 x 31,700)	28,500
Subtotal	$ 923,500
TOTAL AVERAGE ANNUAL BENEFITS	$ 4,072,400
BENEFITS/COSTS: $4,072,500/$2,630,500	1.55
EXCESS BENEFITS	$ 1,441,900

SECTION V - STRUCTURAL MULTIPLE PURPOSE ALTERNATIVES

Reasons for Consideration

In the process of reexamining alternatives previously considered in the final EIS and developing alternatives specifically required by the Court Order, concerns arose over the incremental justification of levees and channels below the lake, particularly in view of the environmental impacts of these measures. More specifically, the Reservoir and Levees plan provides 30-year flood protection to 24,300 acres of which 11,900 acres are wooded, 3,300 acres are semiwooded, and 9,100 acres are cleared. Of the 11,900 wooded acres, induced clearing would be anticipated on 80 percent or 9,520 acres. These wooded lands consist primarily of bottomland hardwoods. Through field investigations and analyses of aerial photographs, topographic maps, and soil surveys approximately 80 percent of the bottomland hardwoods generally distributed below the Cooper damsite are considered wetlands. By deduction, therefore, implementation of the Reservoir and Levees plan would cause clearing of over 7,600 acres of wetlands. This induced destruction must be analyzed in the spirit of EO 11990 which requires agencies to avoid construction in wetlands unless there are no practicable alternatives and all practicable measures to minimize harm to wetlands are included. Furthermore, two of the proposed levees included in the Reservoir and Levees plan (levee 4LSS and levee 4RS) require channelization where levee alignments cutoff the natural river (see plate B). The channel required with levee 4LSS is 3.6 miles in length and on the South Sulphur River. The channel required with levee 4RS is 3.0 miles in length and on the Sulphur River. These channels are designed with 12-foot bottom widths and 1:1 side slopes. Intentional self-enlargement of these channels through erosion is expected to contribute approximately 1,600 acre-feet of sediment to the South Sulphur River flood plain, Sulphur River flood plain, and Wright Patman Lake within the initial 10-year period following construction. This estimate is based on enlargement rates of previous channelization in the Sulphur River watershed. Due to the erosion, these channels cannot be expected to revegetate for at least 10 years.

Implementation of the Reservoir Only plan would significantly reduce environmental impacts downstream of the lake. This alternative, which was considered the best of the partially responsive alternatives evaluated in the final EIS would provide 30-year flood protection to 3,200 wooded acres, 1,500 semiwooded acres, and 8,200 cleared acres. Given that 80 percent of the wooded lands (bottomland hardwoods) are wetlands and 80 percent of the wooded lands would be cleared, this plan can be expected to induce clearing of only about 2,000 acres of wetlands. This is a reduction of 5,600 acres from expected clearing of wetlands with the Reservoir and Levees plan. Also, the bottomland hardwood and wetland areas protected by the

Reservoir Only plan are generally considered of lower quality than the areas incrementally protected by the Reservoir and Levees plan. Cleared and semiwooded acreages protected with the Reservoir Only plan would respectively be 1,800 acres and 900 acres fewer than those protected with the Reservoir and Levees plan. Furthermore, no additional channelization is required with the Reservoir Only plan.

Alternatives Developed

In an attempt to reduce the adverse environmental impacts expected as a result of the levees and channels and also minimize the reduction in cleared and semiwooded areas protected, three alternative levee and channel configurations were considered for implementation with the reservoir. These three alternative configurations are: (1) levees as designed with stable channels in place of those designed for self-enlargement; (2) realigned levees 4LSS and 4RS to eliminate the need for channels; and (3) including only levee 3RS which requires no channelization.

a. Reservoir and Levees with Stable Channels. This alternative would be identical to the Reservoir and Levees plan as shown on plate B except that the two previously described channel segments would be designed such that self-enlargement through erosion would not be expected to occur.

The 3.6-mile channel segment required for levee 4LSS was designed to be stable for the 30-year flow with Cooper Lake. The resulting channel would be trapezoidal with a 35-foot bottom width and 1 on 3 side slopes. A rock stabilization structure would be provided at the lower end of this channel to transition back to the natural channel and to prevent erosion.

The 3.0-mile channel segment required for 4RS was designed to be stable and contain a 6,000 cfs discharge which is roughly equivalent to natural channel discharge. To adequately design for the 30-year discharge at this point would require either an extremely wide channel or 18 inch to 36 inch riprap along the entire length which would become considerably longer than 3.0 miles. With 6,000 cfs design, the 4RS stable channel system would provide protection to essentially the same area as that protected by the Reservoir and Levees plan. This channel would be trapezeidal with a 12-foot bottom width and 1 on 3 side slopes. A rock stabilization structure would be provided at the lower end for transition and erosion control.

b. Reservoir and Realigned Levees. This alternative would differ from the Reservoir and Levees plan shown on plate B in that both levees 4LSS and 4RS would be realigned to eliminate the need for associated channels. The areas protected by these levees in the Reservoir and Levees plan were altered as little as practicable with the realignments.

To realign 4LSS and eliminate the requirement for channelization would require that it be segmented into three levees, two on the north side of the Sulphur River and one on the south side of the South Sulphur River. See sheet 3 of plate B (plate B-3). The uppermost of the two levees on the north side would extend from the existing broken levee 4LSS(B), along the general alignment of the river, and terminate just above McGuyor Branch. The lower levee on the north side would follow generally the alignment of 5LSS. The levee on the south side would extend from the upper end of the short unnamed levee on the South Sulphur River just below 4RSS, along the general alignment of the river, and terminate just above the confluence with Logston Branch. The total length of these three segments of the realigned 4LSS would be approximately 8.5 miles, compared to 4.7 miles for 4LSS as designed in the Reservoir and Levees plan.

To eliminate the requirement for additional channelization for 4RS would involve realignment of approximately 1.5 miles of levee from the north side of the Sulphur River to the south side. This segment is on sheet 7 of plate B and is located north of the upper end of Oliver Lake. The total length of 4RS would remain as designed at 9.8 miles.

c. Reservoir and Levee 3RS. With this alternative, the two levees requiring channelization would be deleted so the resulting plan would be as shown on plate B without 4LSS, 4RS, and their associated channels.

Analysis

None of the three structural multiple purpose alternatives described in this section were considered in the final array. These alternatives were dropped early for a composite of reasons involving the degree of incremental economic justification and environmental impacts which resulted in no significant advantages over the Reservoir Only plan and the Reservoir and Levees plan, both of which were considered in the final array.

a. Economics

(1) Costs. The first costs and average annual charges for the levee and channel increments of the three alternatives considered in this section plus the final EIS Recommended Plan (Reservoir and Levees) are displayed in table 42. The costs of Cooper Lake and 4RSS spur were not included since they are common to all four plans. Also, at this stage costs associated with mitigating for fish and wildlife losses were not included.

(2) Benefits. Table 43 gives acreages protected to the 30-year level by each of the three alternatives considered in this section plus the Reservoir and Levees alternative.

TABLE 42

COSTS OF LEVEE AND CHANNEL ALTERNATIVES 1/
(July 1974 prices; 3-1/4 percent interest; 100-year period of analysis)

($1,000 at July 1974 prices)

	Costs Incremental to Those of Reservoir Only			
	Levees and Channels As Recommended 2/	Levees With Stable Channels	Realigned Levees; No Channels	Levee 3RS Only
FIRST COST				
Federal				
Levees	7,046	6,585	6,928	3,755
Drainage Structures	10	10	10	0
Channels	901	2,666	0	0
Environmental Protection	385	370	393	186
Subtotal	8,342	9,631	7,331	3,941
Engineering and Design	918	1,011	843	493
Supervision and Administion	656	751	582	318
Total - Federal	9,916	11,393	8,756	4,752
Non-Federal				
Rights-of-Way	145	145	120	53
Relocations	13	13	13	13
Total - Non-Federal	158	158	133	66
TOTAL FIRST COST	10,074	11,551	8,889	4,818
ANNUAL CHARGES				
Interest and Amortization	341.3	391.4	301.2	163.3
Operation and Maintenance	32.3	32.3	32.3	14.[illegible]
TOTAL ANNUAL CHARGES	373.6	423.7	333.5	[illegible]

1/ Excludes costs of Cooper Lake, 4RSS spur, and fish and wi[illegible] measures.

2/ Final EIS Recommended Plan ([illegible]

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TABLE 43

AREAS PROTECTED BY STRUCTURAL MULTIPLE PURPOSE ALTERNATIVES

(Acres)

		Areas Incremental to Reservoir Only			
Habitat Type	Reservoir Only	Levees and Channels As Recommended	Levees With Stable Channels	Realigned Levees; No Channels	Levee 3RS Only
Cleared	8,200	900	900	1,900	200
Semi-wooded	1,500	1,800	1,800	1,700	1,000
Wooded	3,200	8,700	8,700	7,000	2,900
Totals	12,900	11,400	11,400	10,600	4,100

To determine total areas protected by any of the four plans involving levees, the incremental areas must be added to areas protected by the multiple purpose reservoir only. Following procedures outlined in Supplement No. 1, GDM No. 2-B, average annual flood damage reduction and intensification benefits at July 1974 prices were computed based on protected acreages as shown in table 43. These benefits are shown in table 44.

Comparing the incremental flood control benefits from table 44 with incremental costs from table 42 will show economic justification for each of the three structural multiple purpose alternatives considered along with the Reservoir and Levees plan. Incremental economic justification, however, was not considered significant to the degree that any of the three alternatives should be considered in the final array for the following reasons:

- o Incremental benefit-cost ratios for the three alternatives range from 1.1 to 1.7.

- o Costs do not include fish and wildlife mitigation costs which would be significant since the three alternatives each protect primarily wooded lands as shown on table 43.

- o The largest flood control benefit category for each of the three alternatives is intensification which is based on clearing of wooded areas, primarily bottomland hardwoods and wetlands for agricultural uses.

b. Environmental Impacts. Each of the three structural multiple purpose alternatives considered in this section adequately addresses the concerns over erosion and subsequent sedimentation problems

TABLE 44

AVERAGE ANNUAL FLOOD CONTROL BENEFITS
FOR STRUCTURAL MULTIPLE PURPOSE ALTERNATIVES

($1,000 at July 1974 prices)

Flood Control Benefit Category	Reservoir Only	Benefits Incremental to Reservoir Only			
		Levees and Channels As Recommended	Levees With Stable Channels	Realigned Levees; No Channels	Levee 3RS Only
Agricultural	294.0	81.0	91.2	134.4	49.8
Nonagricultural	176.0	125.0	195.3	182.1	66.2
Intensification	158.0	358.0	352.0	258.9	81.2
Storage Exchange	100.0	0	0	0	0
Totals	728.0	564.0	638.5	575.4	197.2

resulting from self-enlargement of the required channels. The problems would be solved either by designing the required channels to be stable, realigning levees 4LSS and 4RS to eliminate the need for channelization, or including only levee 3RS which requires no channelization. Conversely, the problem of induced clearing of bottomland hardwoods and wetlands persists with each of the three alternatives. Table 43 shows that wooded land is the primary habitat type incrementally protected by each of the three alternatives. Two of the alternatives would provide 30-year protection to practically the same wooded acreages as would the Reservoir and Levees plan. Although the third alternative (levee 3RS only) would protect significantly fewer wooded acres, protection afforded to cleared and semiwooded lands is also significantly reduced.

SECTION VI - FINAL ARRAY OF ALTERNATIVES

Selection of Final Array

From the final EIS alternatives reexamined in Section II, the water supply without flood control alternatives evaluated in Section III, the comprehensive nonstructural flood plain management plan developed and evaluated in Section IV, and the structural multiple purpose alternatives evaluated in Section V, an array of four alternatives was established for final evaluation and consideration for selection of the best overall plan. The four alternatives were selected based on consideration of pertinent economic and environmental criteria. These four are the Reservoir and Levees plan and the Reservoir Only plan which were the best of the fully responsive and partially responsive plans, respectively, considered in the final EIS; the comprehensive nonstructural flood plain management plan; and the 109 mgd water supply only lake at the Cooper site, which was the water supply alternative considered most likely for implementation in the absence of a Federal multiple purpose project. None of the three additional structural multiple purpose alternatives initially considered were included for reasons of economic and environmental impacts and also because none of these alternatives offered significant overall advantages not found with either the Reservoir and Levees or Reservoir Only plans.

Plan Descriptions

a. Reservoir and Levees. This was the plan recommended in the final EIS for implementation. The plan consists of Cooper Lake at river mile 23.2 of the South Sulphur River to provide storage for flood control and water supply purposes and recreation facilities; 0.9-mile levee 4RSS spur which is required for proper function of the service spillway; and downstream works consisting of approximately 26 miles of levee improvements and 6.6 miles of channelization and floodway clearing. Pertinent data for this plan are found in table 7 (Section II) and details are depicted on plate B. NED costs and benefits for this plan (excluding measures to compensate for fish and wildlife losses) are tabulated below:

FIRST COST	
Cooper Lake (including 4RSS spur)	$58,108,000
Downstream levees and channels	10,074,000
TOTAL FIRST COST	$68,182,000
AVERAGE ANNUAL CHARGES	
Interest and amortization--Cooper Lake	$ 2,096,900
Interest and amortization--levees & channels	341,300
Operation, maintenance, and replacements--Cooper Lake	501,200
Operation and maintenance--levees & channels	32,300
TOTAL AVERAGE ANNUAL CHARGES	$ 2,971,700

AVERAGE ANNUAL BENEFITS

Flood control	$ 1,305,000
Water supply	2,671,500
Recreation	1,111,500
Fish and wildlife	255,200
Area redevelopment	293,200
TOTAL AVERAGE ANNUAL BENEFITS	$ 5,636,400

b. Reservoir Only. This plan was considered the best of the partially responsive plans considered in the final EIS. The plan consists of Cooper Lake at river mile 23.2 of the South Sulphur River to provide storage for flood control and water supply purposes and recreation facilities. The 0.9-mile levee 4RSS spur is also required for proper function of the service spillway. Pertinent data for the lake and 4RSS spur can be taken from table 7 in Section II. Details of the plan are shown on plate C. NED costs and benefits (excluding measures to compensate for fish and wildlife losses) are tabulated below:

FIRST COST	$58,108,000

AVERAGE ANNUAL CHARGES

Interest and amortization	$ 2,096,900
Operation, maintenance, and replacements	501,200
TOTAL AVERAGE ANNUAL CHARGES	$ 2,598,100

AVERAGE ANNUAL BENEFITS

Flood control	$ 741,000
Water supply	2,671,500
Recreation	1,111,500
Fish and wildlife	269,400
Area redevelopment	249,500
TOTAL AVERAGE ANNUAL BENEFITS	$ 5,042,900

c. Water Supply Only Reservoir. This plan is considered the project that local water supply sponsors would most likely implement to meet their water supply demands if a Federal multiple purpose project is not implemented. A lake with a dependable yield of 109 mgd would be built at river mile 23.2 of the South Sulphur River. Levee 4RSS spur would also be required with this lake. No recreation facilities would be provided, but minimum health and safety facilities would be located at existing road ends for those who would use the lake for recreation. Pertinent data found in table 21 and details are shown in figure 5, both of which are in Section III. NED costs and benefits for this plan (excluding measures to compensate for fish and wildlife looses) are tabulated below:

FIRST COST	$53,301,000

AVERAGE ANNUAL CHARGES

Interest and amortization	$ 1,923,200
Operation, maintenance, and replacements	183,200
TOTAL AVERAGE ANNUAL CHARGES	$ 2,106,400

AVERAGE ANNUAL BENEFITS

Flood control	$ 0
Water supply	2,671,500
Recreation	136,500
Fish and wildlife	132,500
Area redevelopment	208,400
TOTAL AVERAGE ANNUAL BENEFITS	$ 3,148,900

d. Nonstructural Flood Plain Management. This plan incorporates several nonstructural measures to reduce flood damages with specific facilities for recreation. The nonstructural flood damage reduction measures include voluntary zoning of agricultural lands to reduce flood damages and maximize net profits, restricting future structural development, maintaining certain levees that would not likely be maintained under a without project condition, and floodproofing two existing residential structures. Recreation features included a trail and park system in a 24,200 acre strip along the South Sulphur and Sulphur Rivers between State Highway 71 at levee D to Thomas Lake Recreation Area at Wright Patman Lake. A more detailed description of the plan can be found in Section IV. Pertinent features of the zoning and recreation plans are shown in figures 6 and 7, also in Section IV. NED costs and benefits (excluding measures to compensate for fish and wildlife losses) are tabulated below:

FIRST COST

Nonstructural flood damage reduction	$ 375,000
Recreation	9,758,000
TOTAL FIRST COST	$10,133,000

AVERAGE ANNUAL CHARGES

Nonstructural flood damage reduction	$ 110,100
Recreation	549,000
TOTAL AVERAGE ANNUAL CHARGES	$ 659,100

AVERAGE ANNUAL BENEFITS

Flood control	$ 183,100
Water supply	0
Recreation	795,000
Fish and wildlife	31,700
Area redevelopment	0
TOTAL AVERAGE ANNUAL BENEFITS	$ 1,009,800

Evaluation

The four alternatives of the final array were evaluated on the basis of economic and environmental considerations to determine the best overall plan for implementation. The first step in evaluation was to determine fish and wildlife habitat losses and the measures that would be required to compensate for these losses. Then, the

alternatives were evaluated both in economic and environmental terms under the assumption that the proposed fish and wildlife mitigation measures would be included with the project. Socio-economic analyses were made, although they did not play as large a role in evaluation and plan selection as did the economic and environmental factors.

a. Fish and Wildlife Compensation Requirements. Fish and wildlife habitat losses anticipated with each of the four alternatives and measures required to compensate for these losses are described in detail in Appendix B, Fish and Wildlife Coordination and Mitigation Plans. USFWS proposed compensation plans were developed in terms of numbers of acres of wooded, semiwooded, and cleared lands in areas upstream of Wright Patman Lake that could be developed to a level that would fully compensate for project losses. Table 45 shows the total acres of mitigation believed justified by the Corps for each alternative along with land acquisition, development, and annual operating costs that are proposed by the Corps for mitigation of terrestrial habitat losses.

TABLE 45

ECONOMIC COMPARISON OF CORPS PROPOSED
TERRESTRIAL HABITAT MITIGATION FOR ALTERNATIVE PLANS
($1,000 at July 1974 prices; 3-1/4 percent interest;
100 year period of analysis)

Mitigation Lands	Reservoir & Levees	Reservoir Only	Water Supply Only	Non-structural
(Acres)	(48,600)	(25,500)	(25,500)	0
First Cost	15,772.7	8,337.9	8,337.9	0
Average Annual Charges	680.2	359.1	359.1	0
Perimeter Lands - Cooper Lake				
First Cost	659.5	659.5	0	0
Average Annual Charges	43.9	43.9	0	0
Totals				
First Cost	16,432.2	8,997.4	8,337.9	0
Average Annual Charges	724.1	403.0	359.1	0

b. Benefit-Cost Analysis. Procedures followed in estimating the benefits of the four plans are described in Appendix C. Cost estimates for each of the plans are shown in more detail in Sections II, III, and IV of this appendix, as appropriate. It should be noted that in some

cases benefits and costs of the Reservoir and Levees plan and the Reservoir Only plan differ from those presented in the final EIS, even though they are both on the July 1974 price level. These differences result from reanalyses made for preparation of the supplemental EIS. Therefore, July 1974 benefit and cost data found in the supplemental EIS and its appendixes should be considered to supersede data in the final EIS where discrepancies are found. Benefits and costs associated with the final array of alternatives are presented in table 46.

The benefit-cost analysis yields two parameters for economic evaluation of alternatives; the benefit-cost ratio and net benefits. The benefit-cost ratio is a measure of rate of return on the total investment and should exceed unity for an investment to be economically justified. Net benefits give the difference between average annual costs and benefits and should be maximized for economic optimization of the scale of the project. From table 46 it can be noted that, although all four alternatives are economically justified, both the benefit-cost ratio (i.e., rate of return) and net benefits are maximized with the Reservoir Only plan. This plan would clearly be the preferred alternative from an economic standpoint.

c. Environmental Analysis. The environmental impacts of each of the four alternatives are described and analyzed in detail in Section V of the supplemental EIS. These impacts are briefly summarized in the following subparagraphs.

(1) Reservoir and Levees. The beneficial impacts of this plan include providing 30-year flood protection to 24,300 acres of agricultural land along the South Sulphur and Sulphur Rivers; 273,000 acre-feet of water supply storage in Cooper Lake and the potential for an additional 120,000 acre-feet of water supply storage in Wright Patman Lake for municipal and industrial water supply; 933,200 recreation days per year; and about 10,000 acres of perimeter project lands to be managed for fish, wildlife, recreation, and flood storage purposes. Adverse impacts include inundation of 19,305 acres and 21 miles of stream; levee and channel construction on approximately 800 acres; induced clearing of 12,820 acres of wooded and semiwooded lands, 7,600 acres of which are considered to be wetlands; temporary air, noise, and water pollution during construction; periodic inundation of all or part of 3,435 acres in the flood control pool; and realignment of 16 miles of river with channel construction. To mitigate for fish and wildlife habitat losses would require acquisition and management of 48,600 acres of primarily wooded land and development of perimeter lands at an average annual cost of $724,100.

(2) Reservoir Only. Beneficial impacts of this plan include 30-year flood protection of 12,900 acres of agricultural lands; 273,000 acre-feet of municipal and industrial water supply storage in Cooper Lake with the potential for 120,000 acre-feet in Wright Patman Lake; 933,200 annual recreation days; and management of 10,000 perimeter acres for fish, wildlife, recreation, and flood control storage.

TABLE 46

BENEFIT-COST COMPARISONS OF THE FINAL ARRAY
($1,000 at July 1974 prices; 3-1/4 percent interest; 100-year period of analysis)

	Reservoir & Levees	Reservoir Only	Water Supply Only Reservoir	Nonstructural Flood Plain Management
FIRST COST				
Project plan	68,182	58,108	53,301	10,133
Fish & wildlife mitigation	16,432	8,997	8,338	0
Total First Cost	84,614	67,105	61,639	10,133
AVERAGE ANNUAL CHARGES				
Project plan	2,971.7	2,598.1	2,106.4	630.6
Fish & wildlife mitigation	724.1	403.0	359.1	0
Total Average Annual Charges	3,695.8	3,001.1	2,465.5	630.6
AVERAGE ANNUAL BENEFITS				
Flood control	1,305.0	741.0	0	183.1
Water supply	2,671.5	2,671.5	2,671.5	0
Recreation	1,111.5	1,111.5	136.5	795.0
Fish and wildlife	255.2 1/	269.4 1/	132.5 1/	31.7
Area redevelopment	293.2	249.5	208.4	0
Total Average Annual Benefits	5,636.4	5,042.9	3,148.9	1,009.8
BENEFIT-COST RATIO	1.53	1.68	1.28	1.60
NET BENEFITS	1,940.6	2,041.8	683.4	379.2

1/ Net monetary losses for sport hunting and trapping would be partially offset with habitat compensation. This is not reflected in fish and wildlife benefits.

Adverse impacts include inundation of 19,305 acres and 21 miles of stream; induced clearing on 4,060 acres of wooded and semiwooded lands, 2,000 acres of which are considered to be wetlands; periodic inundation of all or part of 3,435 acres in the flood control pool; and temporary air, noise, and water pollution during construction. Mitigation for fish and wildlife habitat losses would require acquisition and management of 25,500 acres of primarily wooded lands and development of perimeter lands at an average annual cost of $403,000.

(3) Water Supply Only Reservoir. The beneficial impacts include 273,000 acre-feet of storage for municipal and industrial water supply and about 275,000 recreation days annually. Adverse impacts include inundation of 19,305 acres and 21 miles of stream and temporary air, noise, and water pollution during construction. Mitigation for fish and wildlife habitat losses would require acquisition and management of 25,500 acres of primarily wooded habitat at an average annual cost of $359,100.

(4) Nonstructural Flood Plain Management. Beneficial impacts include allowing 9,900 acres of semiwooded and cleared land in the 30-year flood plain to revert to bottomland hardwoods; increased habitat value on 24,200 acres in the recreation corridor; 542,000 recreation days annually; reduction of fence damages in areas where the need for fences is reduced; and increased productivity on land in the 3- to 30-year flood plain through conversion from grazing to hay production. Adverse impacts include reduced productivity on agricultural land in the 3-year flood plain; removal of 24,200 acres from private ownership; and reduced habitat value on the 3- to 30-year flood plain due to conversion to hay production and clearing of 2,400 wooded acres. No compensation for fish and wildlife habitat losses would be required with the nonstructural flood plain management plan.

Social-Economic Impact Assessment

The principal aim of these investigations was to identify and measure the likely social and economic impacts expected to result from the implementation of the various plans of improvement under consideration for the Cooper Lake and Channels project. When analyzed, these effects formed the basis for evaluations of both the beneficial and adverse contributions attributable to the various plans investigated.

The scope of these investigations encompassed consideration of selected social and economic parameters given "with" and "without" project conditions. These evaluations were made following the requirements set forth in Section 122 of the River and Harbor Act of 1970 (Public Law 91-611) and other Corps procedures. A list of the pertinent social and economic parameters identified and evaluated as part of these studies is displayed in table 47. In addition,

TABLE 47

SOCIAL AND ECONOMIC EFFECT PARAMETERS ADDRESSED IN THE STUDY

Effect Parameter	*Definition Used*	*Measurement Unit Evaluated or Considered*
*Desirable Regional Growth	Development of the population and economy of a region in a manner consistent with the goals and planning objectives of regional, state, and federal planning agencies.	Measured in terms of changes in the output of goods and services in the region, either directly or indirectly through external economies, increased employment, and changes in settlement patterns.
Population Mobility	The ability of a household to move from one residence to another, influencing factors including economic well-being, regional job opportunities, psychological propensity to move, and others.	Net change in income redistribution, labor market analysis, disposable income, and savings.
Population Density	The number of people per unit area.	Number of people per unit area.
*Population Displacement	The removal of residents from an area as a result of the acquisition of land and structures thereon for public works projects.	Number of people displaced.
*Employment/Labor Force	Employment refers to the proportion of the available work force that has jobs; the labor force is defined as all persons 16 years old or older who are employed, seeking employment, or who are working 15 hours a week or more in a family business.	Measures include size, mobility and skills of the available labor force and the number of jobs directly supported by the project plan and types of work required by the plan.
Personal Income/ Per Capita Income	Personal income refers to the income received from wages, salaries, proprietor's income, other labor income, property income, and trasfer payments. Per capita is a function of total personal income divided by population.	Measured in terms of changes in total personal income and per capita income.
Land Use	The existing and potential future manners in which man may utilize various land areas that may be affected by the plan being considered.	Analysis of the present and projected future uses of land in an area.
Transportation	The accessible movement by people to desired destinations from both local and regional points of origin by a variety of rapid, safe, comfortable, and economical means. The movement of commodities given available modes of transportation.	Measured in terms of distances and travel times by means of various transportation modes. Savings in transportation savings given different modal choices.
*Business and Industrial Activity	All commercial and industrial enterprises within the study area.	Measured in terms of desirability of locating a firm in the area and public expenditures to make plan-affected area more attractive for industries and for families.
*Displacement of Farms/ Agricultural Activity	Land taken out of production of plants and animals useful to food and fiber needs of man in favor of other land use.	Measured in terms of land acreages and farm units directly displaced.
*Tax Revenues	Income from taxation by local governments.	Taxation rates, outstanding indebtedness, bonding capabilities, and likely community growth.
*Property Values	The value of material and non-material economic goods, usually referring to real estate when used in conjunction with taxation and local governments.	Measured in terms of property sales, real estate trends, and area development.
*Public Facilities	The physical plants associated with electricity, gas, power, water, sewage, transportation, park, librairies, museums, and similar public services.	Effects in terms of objective measurements, including quantities and dollar values, and subjective terms, such as health, safety, and conveniences.

TABLE 47 (continued)

Effect Parameter	Definition Used	Measurement Unit Evaluated or Considered
*Public Services	The services and goods supplied to the public by means of public facilities and governmental organizations, such as electricity, water, gas, police and fire services, street repairs, park maintenance, and recreation.	Effects in terms of both numbers and dollar values and in terms of subjective judgments relating to quality of services, health, and safety.
*Community Cohesion	The unifying force or attraction of a common interest that keeps a group of people together in a particular area long enough to effect meaningful interactions typified by the establishment of community patterns and a common identity.	Assessment largely by subjective interpretation of those psychological forces that tend to band people into groups such as church congregations, civic clubs, or community organizations.
*Desirable Community Growth	An increase in population and the accompanying economic development of an area or region in a manner that is consistent with goals and planning objectives that does not incur undesirable change.	Gaged subjectively in terms of efrects which aid in the achievement of community goals and national goals.
Recreation/Leisure Opportunities	That portion of recreation participation which is accounted for by persons participating in outdoor recreation activities.	Consideration is given to the needs for adequate outdoor recreational opportunities and facilities to fulfill the potential.
*Aesthetic Values	The subjective value placed on the percep tion of natural or manmade scenic beauty which is composed of factors that include topography, flora, fauna, water, and vistas in various combinations.	Can only be measured subjectively in relation to the philosophy any given individual or group of individuals has concerning that which is beautif[ul] or desirable to the senses or pleasurable to experience.
*Noise	Noise is considered to be unwanted and/or intrusive sound that is objectionable to humans in either volume or duration or that produces an undesirable effect on wildlife.	Subjective assessment of the amount of unwanted and/or intrusive sound.
National Economic Development	The measurement of increases in national productive output, partially reflected in the national product and income accounting framework which measures the flow of goods and services into direct consumption or investment; the value to users of increased output of goods and services, and the value of output resulting from external economies.	Benefit-cost ratio for plan of improvement under consideration and the physical outputs resulting
Archeological Remains	Natural remains, such as fossils, relics, artifacts, and monuments, that evidence past human occupation, presence, and/or activities in the absence of written records.	Significance of site/remains is assessed by the potential of the site to add to the body of knowledge about man's past.
Historical Structures	Structures, with or without their associated sites, whose local, regional, or national significance is associated with past recorded events of whose design makes them of architectural or historical interest	Significance of structure in terms of architecture, style, past use, uniqueness, or association with historic events.

* Denotes items specifically required by Section 122, Public Law 91-611 to be addressed in the impact analysis

the definition used to describe the effect parameter and the measurement unit evaluated in quantitative and/or qualitative terms under "with" and "without" project conditions are presented in the table.

a. Study Procedure. Briefly, the effect assessments involved an iterative process which included the following activities: (1) anticipated project related effects were identified for the relevant social and economic parameters addressed in these studies; (2) analyses were made to quantify and qualify the effects on each effect parameter; (3) displays of the effects were prepared and compared; (4) evaluations were conducted to measure the beneficial and adverse effects associated with each of the management plans. The procedures followed to achieve the study objective were:

(1) Assemble a profile of existing conditions in the study area. This involved assembly of pertinent economic and social data for each of the effect parameters listed in table 47. Because of the size of the project, judgement was applied in determining the types and level of detail for the information presented.

(2) Extend the profile of "without project" conditions over the expected life of the project which would span from 1990 (initial year of the project) to 2090 (final year of project life). Projections were produced for selected future years beginning with the initial year 1990, which reflected the "without condition" for the no action alternative. Conditions were held constant after 2040 over the remaining years recognizing the uncertainties associated with making such a projection that far into the future. These projections of economic and social conditions served as the baseline for comparison of the effects of the various alternative plans.

(3) Prepare "with project" projections for each alternative considered through the expected life of the project. These projections were prepared for comparable periods compiled for the no action alternative. This step of the analysis basically involved comparing the inputs, measures, and outputs resulting from each alternative plan to determine changes likely to occur in each of the effect parameters addressed.

(4) Identify significant effects likely to accrue to implementation of the different management plans. The significant effects were established by determining whether an effect could have a material bearing on the decision making. Consideration was given to such factors as the magnitude of change, scarcity, fragility, resiliency, and public acceptance and/or disapproval in this determination.

(5) Describe and display the significant effects. The effects of each alternative management plan were described objectively and designated as adverse or beneficial. Where practical, the effects are presented in quantitative terms.

(6) Evaluate effects resulting from each plan. Changes in base conditions were measured against the anticipated "with project" profile. Particular efforts were directed in describing the magnitude

of change identified. A summary table was prepared to show the significant adverse and beneficial effects of each plan investigated.

b. Plans Investigated. The study encompassed examination of four alternative plans which provided for different project features and levels of improvements to meet the water resources needs of the Sulphur River watershed. Table 48 briefly outlines the plan objectives and pertinent features provided for under each of the alternative plans considered in detail by the Fort Worth District. The no action alternative, or status quo projected future, is also displayed in table 48.

c. Study Area. In the initial phases of the study, efforts were directed toward addressing the likely effects under "with project" conditions over a fairly broad geographic area. This included examination of the potential effects in 12 counties in the general vicinity of the project. Examinations were made of the causative factors and the related effects produced by each alternative. Through a screening process, the study area was then drawn down to give detailed consideration to the significant effects likely to occur from the improvements. The major impact area was defined to include six counties located adjacent to and most likely affected by the flood control components provided for under each management plan. Major impacts resulting from water supply and recreation components were expected to occur primarily in three counties. The names of the counties in the defined study area and in the identified significant impact areas are presented in table 49.

d. Base Data Sources. Pertinent social and economic data utilized in these evaluations were principally derived from available published documents, prior consultant reports, and Corps reports prepared on the subject project, and from working papers contained in Fort Worth District's files. Extensive new data collection efforts were not undertaken as this readily available information was considered adequate to address and assess the likely impacts resulting from the improvements considered.

e. Future Without and With Project Conditions. Forecasts were prepared on probable future conditions in the study area over the 100-year analysis period (1990-2090). This basically involved projecting changes in population and economic conditions under without project and with project conditions in order to determine the likely impacts resulting from the plans investigated. OBERS Series E Projections, prepared by the Bureau of Economic Analysis, Department of Commerce, served as principal data source in the development of the needed demographic and economic forecasts. The OBERS, State, regional, and SMSA projections were disaggregated to the county level for use in these analysis. Table 50 presents population projections for selected future years under with and without project conditions. As shown in the table, less than one percent difference is predicted between without and with project conditions by the 50th year of project life (2040). Selected social and economic parameters which

TABLE 48

MANAGEMENT PLANS INVESTIGATED IN DETAIL

Planning Objective	No Action (Status Quo)	Reservoir and Levees	Reservoir (Recommended FWD Plan)	Reservoir - Water Supply Only	Comprehensive Nonstructural
Flood Damage Reduction	About 91,200 acres lie in the 30-year flood plain. Of the total, 58,000 acres are wooded, 12,300 acres are semi-wooded, and 18,900 acres consist of cleared lands. An additional 2,000 acres are nonagricultural due to channels or levees and sump areas. Cleared and semi-cleared lands are used mainly for cattle grazing. Present agricultural practices are expected to prevail in the future.	Cooper Lake provides 131,400 acre-feet of flood control storage capacity. There would be 26.9 miles of additional levees and 6.6 miles of channel downstream. Provides 30-year flood protection to about 24,300 acres of agricultural lands.	Cooper Lake with 131,400 acre-feet of flood control storage capacity. Provides 30-year flood protection to about 12,900 acres of agricultural lands.	No provisions for flood damage reduction measures.	About 66,200 acres within the 3-year flood plain proposed to be a natural habitat. About 19,100 acres between the 3- and 30-year flood limits recommended for agricultural use. Encourages flood damage reduction through voluntary changes in farming practices and the adoption of zoning and flood proofing measures for structures within the 30-year flood plain.
Water Supply	Current cultural practices expected to prevail in the future.	Cooper Lake with storage of 273,000 acre-feet to provide an ultimate yield of 169 cfs or 109.0 mgd.	Cooper Lake with storage of 273,000 acre-feet to provide ultimate yield of 169 cfs or 109.0 mgd	Cooper Lake with storage of 273,000 acre-feet to provide an ultimate yield of 169 cfs or 109.0 mgd	No water supply provisions.
Recreation (includes fish and wildlifeP	Private recreation, including hunting and fishing is expected to continue relatively unchanged in the basin	Reservoir to provide 19,305 acres of water surface and 58 miles of shore line, 3,300 acres for parks at 7 sites.	Reservoir to provide 19,305 acres of water surface and 58 miles of shore line, 3,300 acres for parks at 7 sites.	Minimal facilities to be provided for health and safety purposes, including access points and sanitary facilities.	If implemented with a local sponsor, 24,200 acres of land could provide public recreational access within the 3-year flood plain. Parks would be developed at highway crossings.

TABLE 49

LIST OF COUNTIES LOCATED IN THE STUDY AREA
AND IN THE SIGNIFICANT IMPACT AREA

Alternative Investigated	Project Purpose	Counties Located in the Study Area	Counties Identified in the Major Impact Areas
No Action	-	-	-
Reservoir & Levees	Flood Damage Reduction	1/	3/
	Water Supply	1/	2/
	Recreation	1/	2/
Reservoir Only	Flood Damage Reduction	1/	3/
	Water Supply	1/	2/
	Recreation	1/	2/
Water Supply Only	Water Supply	1/	2/
Comprehensive Non-structural	Flood Damage Reduction	1/	3/

1/ Includes Delta, Fannin, Franklin, Hopkins, Hunt, Lamar, Red River, Titus, Collins, Dallas, Kaufman, and Rockwall counties.

2/ Includes Delta, Hopkins, and Hunt counties.

3/ Includes Delta, Hopkins, Franklin, Lamar, Red River, and Titus counties.

TABLE 50

POPULATION PROJECTIONS FOR THE 12-COUNTY STUDY AREA

County	YEAR				
		1990 2/		2039/2089	
	1974 1/	Future Without	Future With 3/	Future Without	Future With 3/
Delta	4,854	4,500	4,500	4,200	5,000
Fannin	22,800	25,200	25,200	35,500	35,000
Franklin	5,856	5,900	5,900	6,300	6,300
Hopkins	21,681	30,900	30,900	46,700	56,000
Hunt	49,380	54,100	54,100	85,600	102,700
Lamar	37,641	43,500	43,500	75,900	75,900
Red River	14,367	15,400	15,400	23,700	23,700
Titus	18,062	16,700	16,700	19,500	19,500
Collins	87,437	211,000	211,000	433,600	433,600
Dallas	1,408,896	1,773,200	1,773,200	2,883,700	2,883,700
Kaufman	34,173	45,600	46,600	71,900	71,900
Rockwall	8,633	20,500	20,500	41,200	41,200
Total	1,713,780	2,246,500	2,246,500	3,727,800	3,755,000

1/ Base Year
2/ Assumed first year of project life
3/ All three structural plans investigated have the same impacts on population projections.

were heavily influenced by changes in population are: recreation, desirable community growth, property values, and land use.

Recreation needs in the affected study area were projected on a day use basis with growth rates based on population data. Experiences at completed lake projects suggest that the primary recreational use of this project falls within the day use category. Recreation attendance at Corps lakes that was reviewed in making these projections were Lewisville Lake (Garza-Little Elm) and Whitney Lake in the Fort Worth District. The day use market area (the geographical area from which 80 percent or more of the day users will originate) was determined from an analysis of project day use zones and per capita use rates on existing similar projects elsewhere. Analysis of influencing factors included competition from other attractions in the region and time-distance-relationships, and demands for facilities identified in the TORP.

Current real estate appraisals were utilized in determining existing and future land values under with and without project conditions. Future estimates on property values were developed by comparing price levels for existing developed and undeveloped lands, and applying the change in value to lands that would be expected to occur as a result of the project. For an example, unimproved agricultural land is estimated to be about $150/acre with intensified land at $400/acre. The difference in value of $250/acre was then applied to those project lands that would be intensified or enhanced. The resulting total value reflects the projected increase of property values for various alternative plans investigated. Property values for residential sites were projected by using the difference between current real estate prices of $400/acre for rural cropland and $1,500/acre for lake frontage property. The difference of $1,100/acre reflects the anticipated increase in residential property values for the impact area.

Projected agricultural activity in the study area was forecasted based on 1975 OBERS Projections, Regional Economic Activity in the U.S., Series E Population Supplement, Agricultural Projections, Volumes 1, 3, and 4, published by Water Resources Council, Washington, D.C. Growth factors were developed for future with and without conditions using comparable data from similar agricultural areas adjacent to the Cooper Lake project. The areas selected for comparison were the Lower Red Region, Upper Trinity Region, and Sabine Region. Projected livestock and agricultural activity within the region was applied to forecast future without conditions through project life 1990-2090. The with project growth rate factors were determined based on changes in land use and the increased net returns the farmer and/or rancher would receive as a result of more intensified use of these lands. A display of agricultural values under with and without project conditions is presented in table 51.

f. Analysis of Alternative Plans. As noted earlier, five alternatives (including without project) were given detailed consideration

TABLE 51

TOTAL VALUE OF AGRICULTURAL PRODUCTS (LIVESTOCK) BY PLAN
(1990-2090)

YEAR							
1974	1990	2000	2010	2020	2030	2040	2090 1/
(in thousands of $)							
Status Quo Plan							
$ 65,071.9	$100,829.0	$123,250.0	$132,781.0	$153,186.0	$176,728.0	$203,889.0	$203,889.0
Reservoir and Levees							
$ 65,071.9	$169,393.0	$207,059.0	$223,072.0	$257,352.0	$296,904.0	$342,534.0	$342,534.0
Reservoir Only 2/							
$ 41,077.0	$ 69,832.0	$ 85,197.0	$ 91,756.0	$105,794.0	$121,982.0	$140,640.0	$140,646.0
Nonstructural Land Use Plan							
$ 65,071.9	$ 99,129.0	$121,300.0	$130,540.0	$150,600.0	$173,760.0	$200,480.0	$200,490.0
Water Supply Only							

Note: This plan is same as Status Quo Plan

1/ Projections held constant from 2040 through 2989
2/ Impacts in Delta and Hopkins counties

in the plan formulation studies. Three of the alternatives (1) without project (status quo or no action), (2) Reservoir and Levee alternative, and (3) Reservoir Only alternative were analyzed in prior studies. As a result of follow-up studies made by the Fort Worth District, two additional alternatives were added: (1) Water Supply Only, and (2) Comprehensive Nonstructural. The following analysis addresses the above five alternatives.

(1) Status quo (no action) alternative. Under this alternative, 91,200 acres of flood plain lands would continue to be flooded intermittently. It is expected that local residents would continue to attempt to control periodic flooding through maintenance of the existing levee system. An inadequate water supply would continue to prevail for much of the service area forcing local water supply sponsors to develop the same or other surface sources. The lack of a dependable municipal water supply is expected to limit the future growth potential of the local study area. Recreation activities are expected to remain at about the present levels. This is due to the lack of public access roads into the flood plain and much of the lands being in private ownership.

(2) Reservoir and Levees. Under this plan, which is a multiple purpose project, there are provisions for flood control, recreation, and water supply components.

The beneficial impacts are:

Land use. Flood protection would be provided for about 24,300 acres of flood plain lands downstream of the reservoir. This flood protection would be provided to the 30-year flood frequency. Approximately 9,520 wooded acres would be cleared for agricultural use.

Property values. It is estimated that values of land adjacent to or downstream of the project will increase from about $16.2 million to about $23.9 million by 2040 resulting in an increase of about $7.7 million. Lake front property of 2,844 acres will increase in value from about $400/acre currently to an estimated $1,500/acre by 2040 for an increase of about $4.2 million. The total increase in property value for the project area is estimated to be about $11.9 million.

Agricultural activity. Value of farm products sold is expected to increase from 1990 to 2040 by about $173 million. This higher rate of return is attributed to the greater productivity of flood plain lands being protected. The area to be impacted from this plan is in Delta, Hopkins, Titus, Lamar, Red River, and Franklin counties. Total increases for this plan in value of farm products sold is about $70 million.

Population. An increase of about 26,400 persons in Delta, Hopkins, and Hunt counties is projected to occur from 1990 through 2040.

Recreation. An increase in recreation days of about 933,200 will occur. This is due to part of the 3,300 acres of land bordering the reservoir being developed for parks and recreational areas, and boating, skiing, swimming, and other water resource activities occurring on the lake.

Water supply. This plan would provide a dependable water supply of 109 mgd for the cities of Cooper, Sulphur Springs, Irving, and others.

Community cohesion. Cohesion within the local areas is expected to be beneficial due to construction of the project. The reservoir will provide a focal point for the communities citizens to rally around.

Aesthetic values. Upon completion of construction activities, the reservoir and improved recreational areas will provide a pleasing scene and more appeal to the local populace and for visitors to the area.

Desirable community growth. Beneficial growth in the local area is anticipated due to a dependable water supply. The reservoir with its recreation activities would significantly increase the desirability of the surrounding communities for those contemplating moves to a rural setting.

Tax revenues. Gross tax revenues resulting from implementation of this plan are estimated to increase from $395,400 in 1990 to about $519,200 in 2040.

The adverse impacts of this plan are:

Displacement of farms. Approximately 132 farm units totaling about 30,000 acres will be displaced due to land purchase and construction of the proposed reservoir. About 800 additional acres would be required for levee and channel rights-of-way.

Displacement of people. About nine families or 21 people will be displaced as a result of construction and subsequent operation of the project.

Land use. The reservoir pool for the water supply and recreation components of the project (including sediment storage) will result in a loss of about 19,305 acres of land. The recreation feature would require about 3,300 acres of land to be used for park lands and other recreational purposes.

Property values. Value of land in the project area including mitigation lands will have a total loss of about $17.2 million.

Mitigation lands. Under this plan an estimated 48,600 acres of land located in Titus, Morris, Bowie, and Cass counties would be

acquired in fee. Of the total 48,600 acres, 39,400 is wooded and 9,200 acres are in native pasture. This loss of land to its present productivity would be an adverse impact.

Tax revenue. Removal of about 79,400 acres of land from tax rolls will decrease tax revenue by about $143,300 for an adverse impact.

(3) Reservoir Only Plan. This plan includes provisions for flood control, water supply, and recreation.

The beneficial impacts associated with this plan are:

Recreation. Recreation days would increase by 933,200. Approximately 3,300 acres of parks and recreational lands would be made available to the public.

Land use. About 12,900 acres would be provided flood protection which, in turn, would permit more intensified agricultural uses of these lands. Approximately 2,560 wooded acres would be cleared for agricultural uses.

Aesthetic values. Construction under this plan would have a temporarily disruptive impact on the aesthetics of the area. The visual appearance will also be temporarily spoiled by vehicle movement, earth removal, and other related construction activities. Upon completion of construction activities, the lake setting with its park and recreation sites would provide an overall aesthetically pleasing environment.

Desirable community growth. Construction of the proposed project will stimulate the local economy. Desirable growth is expected to occur in the area through new residential and commercial facilities. This will be due in part to the dependable water supply and the more attractive environment.

Community cohesion. Following construction of the proposed project, it is expected to be enhanced due to local residents having a focal point in the reservoir which instills pride to an area's people.

Water supply. A dependable water supply of about 109 mgd would be available to Cooper, Sulphur Springs, Irving, and other cities for municipal and industrial uses.

Agricultural activity. An estimated net increase in product value of about $37.5 million by 2040. Value of farm products sold is expected to increase by about $140.5 million from 1990 through 2040.

Population. A net increase of about 26,400 persons in Delta, Hopkins, and Hunt counties is projected by 2040.

Property values. An estimated increase in property values of about $4.7 million on 12,900 acres of land protected from flooding. Also, 2,844 acres of lake front property will increase by about $4.2 million. Total increase in property value is estimated to be about $8.9 million.

Tax revenues. Gross tax revenues from implementation of this plan are estimated to increase from about $395,400 in 1990 to $512,600 in 2040.

The adverse impacts of this plan are:

Land use. Areas inundated by the reservoir would require about 19,305 acres of land which would be irretrievably lost. The recreation feature would require about 3,300 acres of land.

Property values. An estimated total loss of about $12.3 million in property values within the project area, including mitigation lands.

Displacement of farms. Approximately 132 farm units totaling about 30,000 acres will be displaced due to land purchase and construction of the proposed project.

Displacement of people. About nine families, or 21 people, will be displaced due to the proposed project.

Mitigation lands. An estimated 25,500 acres of land in Titus, Morris, Bowie, and Cass counties will be acquired in fee. Of the total 20,300 acres is wooded, and 5,200 is in native pasture.

Tax revenue. Removal of an estimated 55,500 acres from the tax roll will result in a tax revenue loss of about $92,600.

(4) Water Supply Only Plan. This is a single purpose plan providing water supply for municipal and industrial purposes. Limited recreation will occur with the plan.

The beneficial impacts associated with this plan are:

Recreation. Minimal facilities will be provided for health and safety purposes. This will include two boat ramps and 10 turnarounds. Recreation days generated from these facilities being available are estimated to be about 275,000.

Aesthetic values. During the construction activities, the aesthetic appeal of the area would temporarily decrease. Upon completion of the project, the area will be very appealing to those who find water vistas pleasing. There will be an overall beneficial impact within the project area.

Desirable community growth. The improved water supply and the appeal of a rural setting is projected to create a desirable growth rate in the area.

Population. Growth in the study area is estimated to be about 26,400 persons by 2040. The major portion of the population increase is expected to occur in the immediate vicinity of the reservoir.

Community cohesion. Temporary disruptions will occur during land purchase and construction activities. Over the life of the project, community cohesion is expected to be beneficial due to the reservoir serving as a focal point of community pride for the area's residents.

Water supply. A dependable water supply of about 109 mgd would be available to Cooper, Sulphur Springs, Irving, and other cities for municipal and industrial users.

Property values. About 2,844 acres of lake front property will increase in value by an estimated $4.2 million.

Tax revenue. Gross tax revenues will increase from about $27,800 in 1990 to $104,200 in 2040.

The adverse impacts of this plan are:

Land use. Construction of the reservoir will require acquisition of about 22,075 acres of land. Of this total, 19,305 acres will be needed for the water conservation pool and 2,770 acres for a buffer zone for fluctuation in the lake's water levels.

Property values. The purchase of project lands including mitigation lands will result in a loss estimated at about $12.1 million. This will be an irreversible commitment of these lands.

Displacement of people. About nine families, or 21 people, will be displaced due to land acquisition and construction of the reservoir. This should be a short-term adverse impact as most people tend to relocate within the same general area.

Displacement of farms. There will be about 90 farm units totaling 22,075 acres displaced under this plan. These farm units are located within that land area being acquired for construction of the proposed project. This will be a major adverse impact due to the irreversible commitment of lands.

Mitigation lands. An estimated 25,500 acres of land would be acquired in fee under this plan. These lands are located in Titus, Bowie, Morris, and Cass counties. Removal of these lands from their present productivity will result in an adverse impact.

Tax revenue. Removal of 47,575 acres of land from tax rolls will result in a total tax revenue loss of about $98,400.

(5) Comprehensive Nonstructural Plan. A total of about 85,300 acres would be impacted by this plan. Of this amount, about 66,200

acres are recommended to be included in a natural habitat zone. About 9,900 acres of cleared and semicleared land within this zone would naturally succeed to bottomland wooded habitat. There are 19,100 acres in a 3-year to 30-year flood zone, of which 15,000 acres, currently in cattle production, would be reduced to 3,200 acres and 12,700 acres would be put into hay production. In addition, 3,200 acres of currently wooded land would be converted to tree farming land.

The beneficial impacts are:

The 66,200 acres proposed for the natural habitat zone would insure stability for the remaining wildlife population. The return of the land to its natural state would provide adequate areas for animal and bird watching activities.

Land use. A conversion of 12,700 acres of livestock production lands to hay production would have a beneficial impact due to a change to highest and best use of the land.

Recreation. An estimated 570,000 recreation days would be provided under this plan with the acquisition of 24,200 acres for recreation purposes.

Aesthetic values. Designation of 24,200 acres of lands as recreation areas would improve aesthetic values for those persons that enjoy lands remaining in their natural setting.

The adverse impacts are:

Agricultural activity. Farm products sold are estimated to decrease from about $6.7 million under without project conditions to about $5.0 million under with project conditions for a loss of $1.7 million over the life of the project.

Property values. The changes in land use proposed by this plan will result in a loss of about $1.2 million.

Tax revenues. An estimated loss of tax revenues of about $22,000 on project lands due to a change in agricultural activity. In addition, purchase of recreation lands will result in an estimated tax loss of about $55,800. The total estimated loss is $77,800.

g. Summary of Findings. The net effects of the Social-Economic Impact Assessment for the Cooper Dam and Lake project are discussed in the narrative below and displayed in table 52.

(1) Reservoir and Levees plan. Implementation of this plan will lead to a slight increase in population, greatly expanded recreation facilities, and an overall increase in agricultural production. Land uses will change as a result of flood protection downstream of the reservoir. Other land use changes will occur in the immediate vicinity of the reservoir impoundment as demand for lake front residential property expands.

TABLE 52
SUMMARY COMPARISON OF ALTERNATIVE PLANS

	NO ACTION FUTURE WITHOUT PROJECT	RESERVOIR AND LEVEES	RESERVOIR ONLY	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL
1 PLAN DESCRIPTION	The existing flood plain condition with completed portions of levees and channels constructed by the Corps or by local interests, at the date of the May 1971 court in junction is considered the status quo base condition for evaluation of alternatives. The no action alternative consists of projecting the most probable future condition the flood plain in the absence of implementation of other alternatives considered for the Cooper Lake and Channels Project authorization.	A multiple-purpose (flood control water supply, recreation) dam and lake would be constructed at river mile 23.2 of the South Sulphur River. The recreation and water supply pool would require 19,305 acres. The flood control pool has 131,400 acre-feet of storage and would include 3,435 acres at the 30-year frequency flood event. Flood protection would be provided to 12,900 acres of land. Recreation facilities would be provided initially in two park areas, with ultimate development of seven areas totaling 3,300 acres. Twenty-seven miles of downstream levees and 6.6 miles of channels would be constructed to provide 30-year flood protection to 11,400 acres.	A multiple-purpose (flood control, water supply, recreation) dam & lake would be constructed at river mile 23.2 of the South Sulphur River. The recreation and water supply pool would require 19,305 acres. The flood control pool has 131,400 acre-feet of storage and would include 3,435 acres at the 30-year frequency flood event. Flood protection would be provided to 12,900 acres of land. Recreation facilities would be provided initially in two park areas, with ultimate development of seven areas totaling 3,300 acres. About 1 mile of Spur 4RSS levee would be required in conjunction with the outlet works for the reservoir.	A single-purpose water supply only lake would be constructed at the Cooper dam site by one or more of the local sponsors. The water supply pool would require 19,305 acres. A total of 22,075 acres of land would be acquired for the project. Recreation facilities consisting of boat camp access and minimum facilities for health and safety are expected to be provided by the local sponsors, the county, or the state of Texas on acquired lands above the water supply pool.	A largely voluntary land use zoning plan would be implemented by landowners based on expected flood frequency within the flood plain areas, soil types, and erosion hazards. Abandonment of fencing reduce damages would also be implemented, and two houses would be floodproofed within the flood plain. The plan identifies 66,200 acres of primarily wooded land within the 3-year frequency flood plain, which should remain in wildlife habitat with timber management and flood compatible uses. Hay cropping, with high revenues and low flood damage risk is recommended between the 3- and 30-year flood plain zones, and a pasture zone is recommended on slopes above the 30-year flood plain. To meet recreation needs, a 24,200 acre corridor within the 3-year flood plain is recommended for public acquisition and management for fish and wildlife, and stream-oriented recreation.
2 SIGNIFICANT IMPACTS					
* Indicates Section 122, PL 91-611 effect					
ECONOMIC (NED)					
a. FIRST COST					
a. Project Plan		68,182,000	58,108,000	53,301,000	10,133,000
b. Habitat Mitigation		16,432,000	8,997,000	8,338,000	0
Total	0	84,614,000	67,105,000	61,639,000	10,133,000
b. AVERAGE ANNUAL CHARGES		1/	1/	1/	1/
a. Project Plan	0	2,971,700	2,598,100	2,106,400	630,600
b. Habitat Mitigation	0	724,100	403,000	359,100	0
Total	0	3,695,800	3,001,100	2,465,500	630,600
c. AVERAGE ANNUAL BENEFITS					
a. Flood Control	0	1,305,000	741,000	0	183,100
b. Water Supply		2,671,500	2,671,500	2,671,500	0
c. Redevelopment		293,200	249,500	208,400	0
d. Recreation		1,111,500	1,111,500	136,500	795,000
e. Fish & Wildlife		255,200	269,400	132,500	31,700
Total	0	5,636,400	5,042,900	3,148,900	1,009,800
d. BENEFIT/COST RATIO	0	1.5	1.7	1.3	1.6
e. NET BENEFITS	0	1,940,600	2,041,800	683,400	379,200

TABLE 52 (cont.)

	NO ACTION FUTURE WITHOUT PROJECT	RESERVOIR AND LEVEES	RESERVOIR ONLY	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL
ENVIRONMENTAL (EQ)					
a. Natural Resources* 1) Wildlife Habitat	No impact	34,965 acres degraded or lost, 8,655 acres created or improved. Net adverse losses require 48,600 acres of compensation lands	25,405 acres degraded or lost, 8,655 acres created or improved. Net adverse losses require 25,500 acres of compensation lands	21,345 acres degraded or lost, 630 acres created or improved. Net adverse losses require 25,500 acres of compensation lands	2,400 acres degraded. 66,200 acres improved. No mitigation required.
2) Fishery Stream Lake	No impact	Net loss of 37 miles Net gain of 19,305 surface acre lake plus 96 acres of oxbows	Net loss of 21 miles Net gain of 19,305 surface acre lake	Net loss of 21 miles Net gain of 19,305 surface acre lake	No loss or gain. No loss or gain
3) Wetlands	No impact	7,616 acres lost due to flood control. Direct losses to 680 acres plus wetlands in water supply pool	2,048 acres lost due to flood control. Direct loss to 80 acres plus wetlands in water supply pool	Direct loss to 80 acres plus wetlands in water supply pool	Improved quality on 46,400 acres of wetlands
b. Cultural Resources	No impact	Loss of 90 identified sites, mitigated by testing	Loss of 90 identified sites, mitigated by testing	Loss of 90 identified sites, mitigated by testing	No significant adverse or beneficial impact
c. Environmental Quality air* water* noise*	No change	Temporary air, water, and noise pollution; no significant permanent effect	Temporary air, water, and noise pollution, no significant permanent effect	Temporary air, water, and noise pollution, no significant permanent effect.	Slight water quality improvement.
SOCIAL WELL BEING (SWB)					
a. Recreation	No Change	Net beneficial increase in lake-oriented recreation, net adverse impact on stream fishing.	Net beneficial increase in lake-oriented recreation, net adverse impact on stream fishing.	Net beneficial increase in lake-oriented recreation, but use restricted due to lack of accessability and facilities. Net adverse impact on stream fishing.	Net beneficial increase in general recreation and sport hunting potential.
b. Land Use	No Change	Adverse land use change on 30,800 acres of project lands and 48,600 acres of compensation lands.	Adverse land use change on 30,000 acres of project lands and 25,500 acres of compensation lands	Adverse land use change on 22,075 acres of project lands and 25,500 acres of compensation lands	Adverse land use change on 24,200 acres of project lands.
c. Esthetics*	No Change	Significant change in lake area and downstream, may be viewed as beneficial or adverse.	Significant change, mainly in lake area, may be viewed as beneficial or adverse	Significant change in lake area	No change.
d. Desirable Community Growth*	No Change	Net Beneficial	Net Beneficial	Net Beneficial	No change.
e. Property Values*	No Change	Net loss of $5.3 million including compensation lands.	Net loss of $ 3.4 million including compensation lands	Net loss of $ 7.9 million including compensation lands	Net loss of $4.2 million
f. Agricultural Activity	Value of agricultural products is expected to increase by $103 million in study area by 2040 without project	Net gain of $58 million in agricultural value by 2040 over no action	Net gain of $28 million in agricultural value by 2040	Net loss of $9.5 million in agricultural value by 2040	Net loss of $3.2 million in agricultural value by 2040
g. Population	Slight increase	Net increase of 26,400 persons to study area by 2040	Net increase of 26,400 persons to study area by 2040	Net increase of 26,400 persons to study area by 2040	No change.
h. Displacement of people*	No impact	21 people displaced	21 people displaced	21 people displaced	No displacement.
i. Displacement of farms*	No impact	132 farm units displaced	132 farm units displaced	Estimated 90 farm units displaced	Small portions of numerous ownerships displaced by recreation corridor.
j. Community Cohesion*	No impact	Net beneficial impact	Net beneficial impact	Net beneficial impact.	No change.
k. Tax Revenues*	No change	$19,500 annual loss in tax revenue	$24,600 gain in tax revenue	$22,000 loss in tax revenue	$77,800 loss in tax revenue

TABLE 52 (cont.)

	NO ACTION FUTURE WITHOUT PROJECT	RESERVOIR AND LEVEES	RESERVOIR ONLY	WATER SUPPLY ONLY	COMPREHENSIVE NONSTRUCTURAL
PLAN EVALUATION					
Contributions to Planning Objectives					
a. Flood Control	No contribution, flood damages continue	24,300 acres protected to 30-yr frequency	12,900 acres protected to 30-year frequency	No contribution	19,100 acres managed for greater benefits, lower flood damages; two houses protected, and fence damage reduced.
b. Water Supply	No contribution, water supply needs not met	273,000 acre-feet of storage gained	273,000 acre feet of storage gained	273,000 acre-feet of storage gained	No contribution
c. Recreation (General)	No contribution, recreation demand not met	741,000 man-days gained	741,000 mandays gained	182,000 mandays gained	530,000 mandays gained
d. Fish & Wildlife	No contribution, no adverse or beneficial changes	Loss of 37 miles of stream and 2254 man-days stream fishing. Terrestrial mitigation will offset ecological losses, and sport hunting/trapping. Positive contributions are 192,200 man days lake fishing	Loss of 21 miles of stream and 2254 mandays stream fishing. Terrestrial mitigation will offset ecological losses and sport hunting/trapping. Positive contributions are 192,200 man days lake fishing.	Loss of 21 miles of stream and 2254 mandays stream fishing. Terrestrial mitigation will offset ecological losses, and sport hunting/trapping. Positive contributions are 96,100 mandays lake fishing.	12,000 mandays sport hunting gained.
PLAN RESPONSE					
a. Acceptability	Unacceptable to local interests, authorization would not be met	Known to be supported by local interests. Mitigation expected to be controversial.	Known to be supported by local interests. *Mitigation expected to* be controversial	Expected to be supported by local in*terests in absence of Federal* participation. Mitigation would be doubtful.	Acceptability unknown. Flood plain management aspects may be acceptable, recreation expected to be controversial.
b. Completeness	No action taken, incomplete	Partially satisfies all four planning objectives	Partially satisfies all four planning objectives.	Partially satisfies three planning objectives.	Partially satisfies three planning objectives.
c. Effectiveness & Efficiency	Problems and needs would remain unaddressed, flood damages would continue	Including terrestrial compensation, this plan is the second most efficient in terms of benefits/costs and net excess benefits	Including terrestrial compensation, this plan is the most efficient in terms of benefit/costs and net excess benefits	This plan is the third most efficient in terms of net excess benefits, and fourth in benefit cost.	This plan is least efficient in net excess benefits, but has a low cost and relatively high benefit/cost ratio.
d. Certainty	Relatively uncertain over 100 year period (0-50%)	Impacts and contributions to planning objectives are relatively certain (90%)	Impacts and contributions to planning objectives are relatively certain (90%)	Timing and degree of implementation are relatively uncertain (50-90%) with regard to water supply and recreation.	Implementability and degree of certainty are low (0-50%) for flood plain management and recreation aspects.
e. Geographic Scope	All study areas	Sulphur River flood plain, recreation market area, and water supply service area	Sulphur River flood plain, recreation market area, and water supply service area.	Water supply service area and recreation market area.	Sulphur River flood plain and recreation market area.
f. Benefit/Cost Ratio	N/A	1.5	1.7	1.3	1.5
g. Reversibility	Completely reversible	Irreversible, lake area and downstream	Irreversible, lake area and partially downstream	Irreversible, lake area	Completely reversible
h. Stability	Relatively Stable (slow change predicted)	high	High	High	Low
RANKING OF PLAN	5	2	1	3	4
IMPLEMENTATION RESPONSIBILITY	Not applicable	Fully implementable by Corps with local sponsors for water supply storage and levee construction	Fully implementable by Corps with local sponsors for water supply storage	Not implementable by Corps under present civil works authorities. Implementable by one or more local sponsors without Federal participation.	Not implementable by Corps under present authorization, but authorization could be requested for flood proofing aspects. Would require local sponsor to provide lands for recreation and zoning aspects. Technical assistance and other minor aspects are implementable by SCS, Corps of Engineers.

The major long-term economic benefits accruing to the local area as a result of construction of Cooper Dam and Lake include flood damage reduction on about 24,300 acres downstream of the reservoir, an adequate water supply, and induced growth in the reservoir area due to recreational activity and new residential construction. In the vicinity of the reservoir, land use and property value changes can be expected between 1990 and 2040 as new population, new residences, and commercial establishments are attracted to the area. Downstream of the reservoir, a long-term increase in agricultural productivity will occur due to flood damage reduction with accompanying intensification of agricultural lands. Opportunities for future growth in the Cooper-Sulphur Springs area will be enhanced by an adequate water supply afforded by the reservoir.

The adverse impacts associated with this plan include a loss in agricultural land and temporary disruption in community cohesion due to the displacement of nine families. Project land values will sustain a net loss and about 132 farm units will be displaced. Aesthetic value will suffer in the opinion of some who prefer the undeveloped landscape; others will prefer the lake and its surroundings.

The major social benefits resulting from the project is the provision for an estimated 933,200 recreation days and the greatly enhanced aesthetic appeal of the area due to park facilities and water related activities.

(2) Reservoir Only. The impacts associated with this plan are essentially the same as the Reservoir and Levees plan. A slight increase in population expanded recreation facilities and an increase in agricultural production. Land uses will change as a result of flood protection downstream of the reservoir. Other land use changes will occur in the immediate vicinity of the reservoir as demand for residential property increases.

The major long-term economic benefits occurring to the local area as a result of construction of Cooper Dam and Lake include flood damage reduction on about 12,900 acres downstream of the reservoir, an adequate water supply of 109 mgd, and induced growth in the vicinity of the reservoir resulting from increased recreational activity and new residential construction. Land use and property values will change between 1990 and 2040 as new residents and commercial establishments are attracted to the area. A long-term beneficial increase in agricultural production will occur downstream of the reservoir due to intensification of lands protected from flooding. Opportunities for growth in the surrounding area will be enhanced by the water supply afforded by the reservoir. The major social benefits resulting from the project are an estimated 933,200 recreation days by 2040, and the aesthetic appeal of the area after construction activities have ended.

The adverse impacts associated with this plan include a loss in agricultural land and temporary disruption in community cohesion due

to the displacement of nine families. Project land values will sustain a net loss and about 132 farm units will be displaced. Aesthetic value will suffer in the opinion of some who prefer the undeveloped landscape; others will prefer the lake and its surroundings.

(3) Water Supply Only. Implementation of this plan will lead to a slight increase in population, minimum recreational use, and changes in land use in the vicinity of the reservoir.

The long-term economic benefits associated with this plan include an adequate water supply of 109 mgd and induced growth around the reservoir and immediate area due to the increased recreational activity and demand for residential construction. In the vicinity of the reservoir, land use and property values changes can be expected between 1990-2040 as new population, new residences, and commercial establishments are attracted to the area. Opportunities for future growth will be enhanced by the reservoir.

The major social benefits resulting from the project is the provision of an estimated 275,000 recreation days by 2040, and the enhanced aesthetic appeal of the area due to a large body of water which has appeal to some.

The adverse impacts that will occur as a result of this plan is the acquisition of 22,075 acres of land for project purposes which will be an irreversible loss, and a loss in land values. In addition, about 90 farm units with displacement of approximately nine families will occur. A temporary disruption in community cohesion will occur due to construction activities and aesthetic appeal may suffer as some prefer undeveloped river basin landscape.

(4) Comprehensive Nonstructural Plan. Implementation of this plan would lead to a decline in livestock productivity, a conversion of about 9,900 acres of existing pasture land to its natural state, and a loss in property value of about $4.2 million.

The beneficial impacts associated with this plan would be the return of 9,900 acres to wooded land which would enhance wildlife and the natural condition. The 66,200 acres of land recommended for a natural habitat zone would benefit the existing wildlife population. Activities such as bird watching and hiking would be enhanced on the 24,200 acre recreation corridor.

The adverse impacts are an estimated loss in livestock productivity due to conversion of 12,700 acres of existing land from its present use and the adversity of the local areas continuing efforts to provide an adequate water supply. The acquisition of about 24,200 acres of bottomland within the 3-year flood zone for recreation purposes will result in a loss of tax revenue estimated to be about $55,800.

Summary Comparison of Alternative Plans

A display of the net results of economic, environmental, and socio-economic analyses related to the four alternatives of the final array is presented in table 52.

Selection of Supplemental EIS Recommended Plan

Based on evaluations and assessment of impacts of the four alternatives of the final array, the Reservoir Only plan was selected for implementation. This plan was shown to be the best economically both in terms of benefit-cost ratio (1.7) and net benefits ($2,041,800). The plan would satisfy the municipal and industrial water supply needs of local sponsors through the year 2030 as well as make possible the conversion of 120,000 acre-feet of flood control storage in Wright Patman Lake to water supply. The plan would provide 30-year flood protection to 12,900 acres, over 75 percent of which are either cleared or semiwooded. In contrast, although the Reservoir and Levees plan would provide 30-year protection to 24,300 acres, the cleared and semiwooded portion would only be 50 percent. The remaining 11,900 acres are wooded, consisting almost exclusively of bottomland hardwoods and wetlands. The Reservoir Only plan would require almost one-half the acres of land to mitigate for fish and wildlife habitat losses as would the Reservoir and Levees plan. The Water Supply Only plan would require about the same acreage, though actual mitigation by a non-Federal sponsor is speculative.

The Comprehensive Nonstructural plan would cause fewer and less severe environmental impacts but it would not satisfy water supply needs without the addition of a reservoir, and would be rather uncertain in terms of flood damage reduction and intensification outputs due to the voluntary nature of the agricultural zoning portion of the plan.

SECTION VII - RECOMMENDED PLAN

Plan Description

The Reservoir Only plan which was selected for implementation as a result of the supplemental EIS studies consists of Cooper Lake and levee 4RSS spur. Pertinent data from these features is found in table 7 of this appendix. The plan is depicted on plate C.

The plan remains as previously described in Sections II and VI of this appendix.

As previously described, the Reservoir Only plan reduces the 30-year flood plain downstream of the dam along the South Sulphur and Sulphur Rivers by approximately 12,900 acres. This area is shown on plate E between the existing and modified 30-year flood plain delineations.

Hydropower Analysis

A preliminary analysis was undertaken to determine the potential feasibility for the addition of hydroelectric generating facilities to Cooper Lake under current conditions. The flow-duration technique described in "Feasibility Studies for Small Hydropower Addition, A Guide Manual" (published in July 1979 by the Hydrologic Engineering Center and the Institute for Water Resources) was used in this analysis. The dependable water supply yield of 164 cfs (excluding 5 cfs designated for low flow releases) was subtracted from available flows since all water supply contractors are expected to divert water from the lake upstream of the dam. Additional losses to evaporation, seepage, and leakage will occur but were not included in calculations. The 15 percent point was chosen for installed capacity which resulted in a design flow of 210 cfs. Head was chosen by assuming a constant pool elevation of 440 feet msl, a constant tailwater elevation of 397 feet msl, and a 1-foot friction head loss through the pentstock; resulting in a net head of 42 feet. Turbine operation was assumed permissible from 30 to 110 percent of design flow. These assumptions yielded an installed capacity of approximately 600 kw and an average annual energy of 1,038.7 mwh. Benefits of $35,600 annually were computed using unit values for capacity and energy as furnished by the Federal Energy Regulatory Commission for the Southwest Power Pool. Average annual costs totaling $67,800 at 3-1/4 percent interest were estimated using "Hydropower Cost Estimating Manual" published in May 1979 for the Institute for Water Resources by the Portland District, Corps of Engineers. The resulting benefit-cost ratio of 0.54 indicates that hydropower would not be a feasible addition to Cooper Lake. It should be noted that liberal assumptions were made in this analysis so a more detailed analysis would likely yield an even lower benefit-cost ratio.

Recreation Analysis

The methodology used for predicting recreation needs follows the instructions presented in ER 1120-2-403 dated 26 March 1970. The procedure utilizes the "similar project" concept for recreation prediction. This technique involves using recreation information from existing projects of the same approximate size and character. The similar projects used in the 1980 analysis were Canton Lake in the Tulsa District and Somerville and Whitney Lake in the Fort Worth District. The previous (1974) analysis used Whitney and Lewisville Lakes as similar projects. Lewisville Lake was not included in the 1980 analysis because it now has urban lake visitation characteristics which are not fully applicable to the Cooper Lake market area.

a. Day Use Market Area. Experience at completed lake projects in the Fort Worth District and at similar projects elsewhere suggests that the primary recreational use of this project falls within the day use category. The day use market area (the geographical area from which 80 percent or more of the day users will originate) was determined from an analysis of project day use zones and per capita use rates on existing similar projects elsewhere. Analysis of influencing factors included competition from other attractions in the region and time-distance-use relationships. The principal day use area was determined to be approximately 100 road miles from the project. The Cooper Lake market area is shown on figure 8.

b. Existing Population Characteristics. The existing population of the day use market area is a mixture of urban and rural populations. Population data for the market area is shown by county in table 53.

c. Projected Population. The population within the day use market area was projected from the base year 1990 (year project assumed to be sufficiently filled for pursuit of recreational activities) through the year 2030. These projections were based on OBERS series E population projections. A summary of the projections by decade shown in table 54.

d. Existing Recreational Opportunities. There are numerous recreational opportunities existing in and near the Cooper Lake area. These opportunities are provided by both the private and public sectors and in some instances, a combination of the two. These existing opportunities are discussed in detail in the final EIS, pages II-54 through II-67.

e. Recreation Needs. In recent years, the demand for outdoor recreation opportunities has rapidly increased throughout Texas. Changes in factors such as population, urbanization, leisure time, buying power, and recreational preferences have created a tremendous pressure on public agencies and private entities to provide more outdoor recreation opportunities. Under the provisions of the Land and Water Conservation Fund Act, each state must develop, maintain,

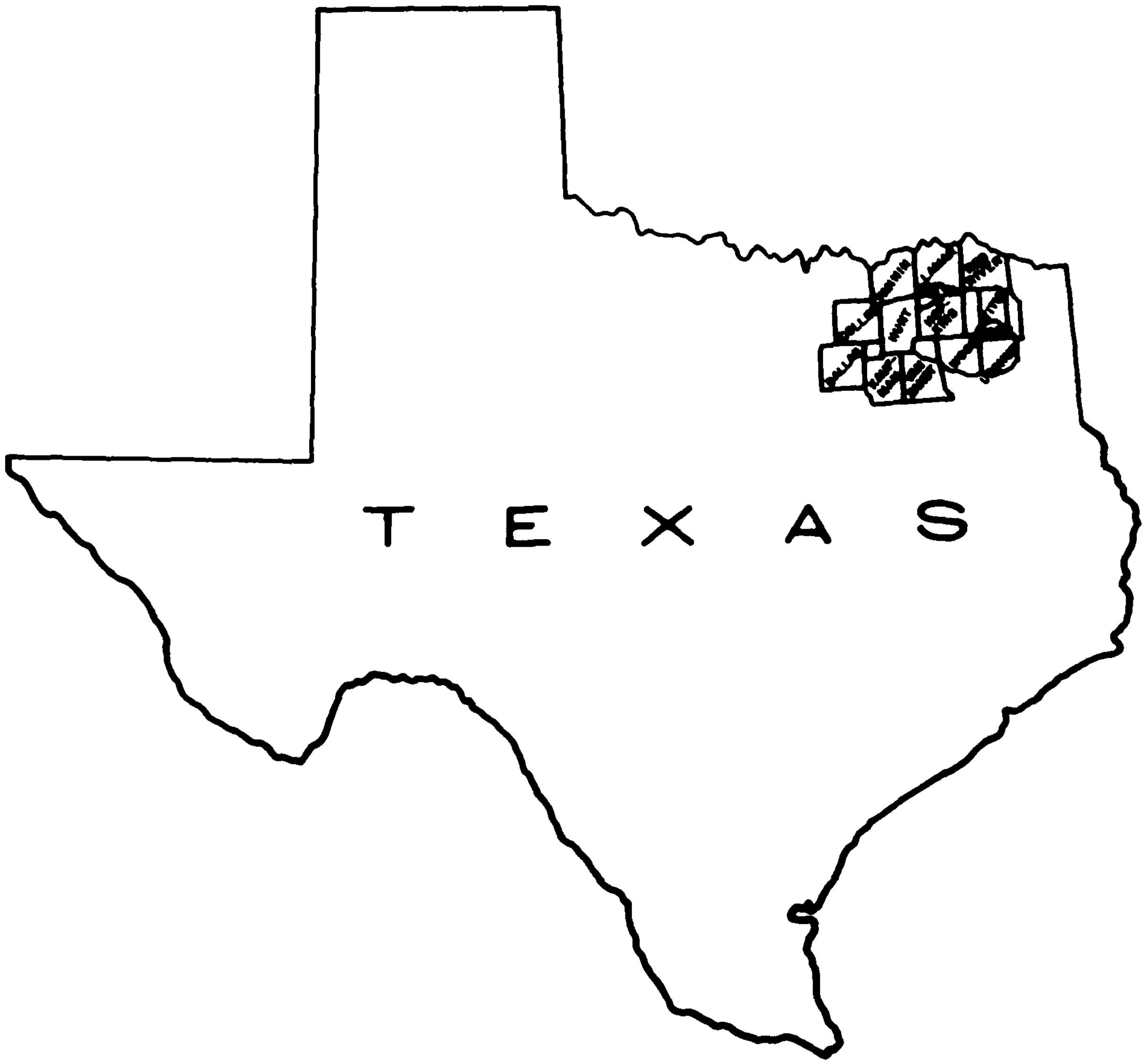

FIGURE 8 - RECREATION MARKET AREA

TABLE 53

MARKET AREA POPULATION BY COUNTIES

County	1960 Population	1970 Population
Camp	7,849	8,005
Collin	41,247	66,920
Dallas	951,527	1,327,321
Delta	5,860	4,927
Fannin	23,880	22,705
Franklin	5,101	5,291
Hopkins	18,594	20,710
Hunt	39,399	47,948
Kaufman	29,931	32,392
Lamar	34,234	36,062
Morris	12,576	12,310
Rains	2,993	3,752
Red River	15,682	14,298
Rockwell	5,878	7,046
Titus	16,785	16,702
Upshur	19,793	20,976
Van Zandt	19,091	22,155
Wood	17,652	18,589
	1,268,073	1,688,109

Source: Texas Almanac (1978-1979)

TABLE 54

PROJECTED POPULATION IN THE MARKET AREA

County	1990	2000	2010	2020	2030
Camp	8,100	7,900	7,600	7,200	7,100
Collin	211,000	283,600	316,200	352,600	393,100
Dallas	1,773,200	1,995,000	2,192,100	2,408,300	2,646,000
Delta	4,500	4,400	4,400	4,400	4,400
Fannin	25,200	26,400	28,200	30,500	33,000
Franklin	5,900	6,100	6,100	6,100	6,200
Hopkins	25,900	29,700	30,400	31,200	32,400
Hunt	54,100	57,800	63,800	69,800	76,700
Kaufman	45,600	52,400	57,600	63,300	69,600
Lamar	43,476	48,770	54,300	60,900	68,400
Morris	13,300	12,900	12,400	11,900	11,400
Rains	4,400	4,700	4,800	5,000	5,100
Red River	15,442	16,281	17,400	19,100	21,400
Rockwell	20,500	27,000	30,100	33,600	37,400
Titus	16,700	16,200	17,200	18,100	18,800
Upshur	24,000	24,400	25,000	25,400	26,000
Van Zandt	24,400	25,500	26,800	28,100	28,900
Wood	19,800	19,700	19,000	18,300	18,000
	2,335,518	2,658,751	2,913,400	3,193,800	3,503,900

and keep up-to-date a statewide comprehensive outdoor recreation plan. In response to the requirement, the Texas Outdoor Recreation Plan (TORP) of 1975 has been prepared and provides the guide for outdoor recreation development in Texas.

The recreation market area for Cooper Lake includes 18 Texas counties and overlaps TORP planning regions 11, 12, 13, and 14.

Corps of Engineers studies and the TORP indicate that a wide deficit exists between the projected recreational needs in the recreation market area and the output capacities of all existing and proposed recreational outlets. All studies recognize that there is a critical shortage of recreation facilities for all activities in all planning regions overlapping the recreation market area. It is expected that the continued growth in participation in sport fishing activities will necessitate additional lakes, freshwater boat ramps, fishing piers, barges, and marinas. Additionally, there is a need for improved access to existing lakes and streams and for better management of these existing resources.

Indications are that recreation needs will continue to exceed the number of facilities being provided and that additional recreational outlets will be needed to help reduce this deficit. (The cost of facilities required to meet these needs would be subject to cost sharing by a non-Federal entity under the provisions of Public Law 89-72).

Based on comparisons of current and future demands for hunting lands, there will be a tremendous need for additional hunting lands in the South Sulphur River basin in the future. A number of special problems exist with regard to providing adequate hunting opportunities in Texas. According to the TORP, the foremost among these problems is the lack of access to private lands suitable for hunting. Other problems are high cost, restrictive leasing practices of private landowners, crowded conditions and public hunting lands, less than optimum distribution of wildlife and lands available for hunting, low harvest rates, and the critical loss of high quality wildlife habitat from competing land uses. The alleviation of these problems would make the most effective contributions toward providing more adequate hunting opportunities for Texas.

According to the TORP, there is a need to acquire areas that are unique or that have particular value for wilderness preservation. Special attention will be given to preserving the critical bottomland hardwood and coastal marsh areas that still exist in a relatively undisturbed state. Recreation in these areas should revolve around low impact, low density use with emphasis on interpretive programs. Special consideration should be given to acquisition of wilderness areas close to urban centers.

The need for preservation of natural areas for open space and fish and wildlife management is increasingly apparent as more existing areas are encroached upon by commercial or housing developments and more intensified land use. The State of Texas has identified sections of streams and rivers which have potential for wild, scenic, or recreational waterway designation and has also identified areas having potential for future trail development.

The South Sulphur River, because of extreme fluctuations in water levels, does not maintain a desirable flow of canoeing, kayaking or rafting, and channelization has reduced the desirability of the natural, scenic, and recreational qualities of these water courses to the point where little or no waterway recreation participation presently occurs. The South Sulphur River does not meet the requirements for Federal or state wild, scenic, or recreational river designation.

The acquisition and development with recreation facilities of all or portions of the Sulphur River flood plain would have a beneficial impact on the area by restoring and maintaining natural, scenic, and recreational qualities which in time could make the South Sulphur River desirable for inclusion in a statewide system of waterways as a recreational waterway.

The Texas Parks and Wildlife Department (TPWD) in its Texas Trailways report points out that opportunities for dispersed-type recreational activities such as hiking, backpacking, bicycling, horseback riding, nature study, and primitive camping in natural settings close to home are rare and unusual occurrences, and that flood plains have excellent potential for trail development. The Texas Trailways report also indicates that the Arkansas-Texas Council of Governments has proposed a trail system which would connect Cooper Lake and its recreational facilities with facilities at Wright Patman Lake.

f. Resource Requirements. The recreation resources requirements (needs) are shown by region for selected outdoor recreation activities in tables 55, 56, 57, and 58. Table 59 presents a summary of these requirements.

g. Determination of Recreation Use.

(1) Selection of per capita use rate. In order to minimize the chance of an erroneous attendance based on a unique situation, recreation use data from similar projects were pooled to derive a per capita use curve. The per capita use curve automatically takes into consideration competition from other lakes in the area of the similar project, since the visitation records are actual use. For example, actual recorded visitation at Lake Whitney occurred despite competing use from Waco, Bardwell, Navarro Mills, Belton, Stillhouse Hollow, Proctor, Benbrook, and several non-Federal lakes within 100 miles of the dam. The per capita use rate curves for three similar

TABLE 55

RESOURCE REQUIREMENTS FOR RECREATION
FACILITIES IN TORP REGION 11

Recreation Resource	Unit of Measure	Rural Resource Requirement 1980	Rural Resource Requirement 2000	Urban Resource Requirement 1980	Urban Resource Requirement 2000
Park land	Acre	2,564	7,061	17,331	58,438
Hunting lands	Acre	135	190	-	-
Camping	Site	159	264	-	-
Playgrounds	Acre	39	134	252	1,808
Picnicking	Table	2,090	5,211	69	1,217
Boat ramps	2 lanes/ramp	37	116	54	196
Fishing facilities	Lin. Yds.	472	727	-	-
Bicycle trails	Mile	3	9	106	350
Horseback riding trails	Mile	86	272	-	-
Combined trails (Walk, hike, nature study)	Mile	0	0	242	653
Recreation water	Surface Acre	0	0	2,560	15,697
Swimming beaches	Sq. Yds.	625	2,310	-	-

SOURCE: TORP, Regional Summary Volume, Region 11, Dallas Area, page 78.

Note: Dashes indicate not applicable.

TABLE 56

RESOURCE REQUIREMENTS FOR RECREATION FACILITIES IN TORP REGION 12

Recreation Resource	Unit of Measure	Rural Resource Requirement 1980	Rural Resource Requirement 2000	Urban Resource Requirement 1980	Urban Resource Requirement 2000
Park land	Acre	17,143	39,402	157	1,329
Hunting lands	Acre	365	884	-	-
Camping	Site	6,625	12,669	-	-
Playgrounds	Acre	2	27	0	0
Picnicking	Table	9,019	20,492	35	58
Boat ramps	2 lanes/ramp	355	872	12	23
Fishing facilities	Lin. Yds.	1,062	7,112	-	-
Bicycle trails	Mile	150	346	1	2
Horseback riding trails	Mile	221	585	-	-
Combined trails (Walk, hike, nature study)	Mile	109	239	1	23
Recreation water	Surface Acre	0	0	974	1,911
Swimming beaches	Sq. Yds.	4,652	16,944	-	-

SOURCE: TORP, Regional Summary Volume, Region 12, page 84.

Note: Dashes indicate not applicable.

TABLE 57

RESOURCE REQUIREMENTS FOR RECREATION FACILITIES IN TORP REGION 13

Recreation Resource	Unit of Measure	Rural Resource Requirement 1980	Rural Resource Requirement 2000	Urban Resource Requirement 1980	Urban Resource Requirement 2000
Park land	Acre	2,058	5,737	719	1,480
Hunting lands	Acre	0	173	-	-
Camping	Site	978	1,986	-	-
Playgrounds	Acre	2	21	0	19
Picnicking	Table	1,371	4,620	0	5
Boat ramps	2 lanes/ramp	27	75	4	8
Fishing facilities	Lin. Yds.	299	883	-	-
Bicycle trails	Mile	2	4	4	7
Horseback riding trails	Mile	7	17	-	-
Combined trails (Walk, hike, nature study)	Mile	13	42	14	28
Recreation water	Surface Acre	0	0	277	615
Swimming beaches	Sq. Yds.	216	969	-	-

SOURCE: TORP, Regional Summary Volume, Region 13, page 90

Note: Dashes indicate not applicable.

TABLE 58

RESOURCE REQUIREMENTS FOR RECREATION
FACILITIES IN TORP REGION 14

Recreation Resource	Unit of Measure	Rural Resource Requirement 1980	Rural Resource Requirement 2000	Urban Resource Requirement 1980	Urban Resource Requirement 2000
Park land	Acre	12,039	27,559	1,077	2,592
Hunting lands	Acre	0	194	-	-
Camping	Site	3,411	6,942	-	-
Playgrounds	Acre	2	19	0	0
Picnicking	Table	3,725	9,969	48	65
Boat ramps	2 lanes/ramp	224	558	5	11
Fishing facilities	Lin. Yds.	2,956	5,836	-	-
Bicycle trails	Mile	138	268	21	53
Horseback riding trails	Mile	337	757	-	-
Combined trails (Walk, hike, nature study)	Mile	236	501	26	49
Recreation water	Surface Acre	0	0	237	808
Swimming beaches	Sq. Yds.	2,797	7,535	-	-

SOURCE: TORP, Regional Summary Volume, Region 14, page 96.

Note: Dashes indicate not applicable

TABLE 59

RESOURCE REQUIREMENTS FOR RECREATION
FACILITIES IN TORP REGIONS 11, 12, 13, AND 14

Recreation Resource	Unit of Measure	Rural Resource Requirement 1980	Rural Resource Requirement 2000	Urban Resource Requirement 1980	Urban Resource Requirement 2000	All Areas 1980	All Areas 2000
Park land	Acre	33,804	79,759	19,284	64,339	53,088	144,098
Hunting lands	Acre	500	1,441	-	-	500	1,441
Camping	Site	11,173	21,861	-	-	11,173	21,861
Playgrounds	Acre	45	201	252	1,827	297	2,028
Picnicking	Table	16,205	40,292	152	1,345	16,357	41,637
Boat ramps	2 lanes/ramp	643	1,621	75	238	718	1,857
Fishing facilities	Lin. Yds.	4,789	14,558	-	-	4,789	14,558
Bicycle trails	Mile	293	627	132	412	425	1,039
Horseback riding trails	Mile	651	1,631	-	-	651	1,631
Combined trails (Walk, hike, nature study)	Mile	358	782	283	753	641	1,535
Recreation water	Surface Acre	0	0	4,048	19,031	4,048	19,031
Swimming beaches	Sq. Yds.	8,290	27,758	-	-	8,290	27,758

SOURCE: TORP, Regional Summary Volume, Region 11, 12, 13, and 14 pages 78, 84, 90, and 96.

projects are shown on figure 9. Figure 9 also shows a theoretical use rate curve for the Cooper project. The selection of the per capita use rate curve for Cooper was adjusted through "planner's judgment" to reflect dissimilarities in the projects, competing recreational resources in the market area, and the availability and cost of fuel.

(2) Estimating total initial recreation use. After the population and per capita use rate is determined, the per capita rate multiplied by the county population gives the expected initial recreation day-use for the base year 1990 from within the market area. It has been found that the initial recreation use from within the market area will constitute about 90 percent of the total recreation use with approximately 10 percent originating from outside the market area. From the project survey data, overnight use is estimated to be 18 percent of the total use. The total initial recreational use (base year 1990) are computed in table 60.

(3) Projection of potential recreation use. An important part of the recreation analysis of the proposed project is the estimation of potential future recreation use. Although there are many factors that may affect future recreation attendance projections, there are essentially two basic items to be considered: (1) anticipated increase in future per capita use rates, and (2) population projections. Because present recreation participation rates on existing projects are increasing and are predicted to continue increasing, the initial per capita rates must be adjusted to reflect the anticipated increase in per capita rates by decade. The initial per capita rate was adjusted by the factors presented in table 61.

TABLE 61

ADJUSTMENT FACTORS FOR PER CAPITA USE RATES

1990	1.00
2000	1.14
2010	1.27
2020	1.38
2030	1.48

Then the adjusted per capita use rates were applied to the population projections to arrive at the resulting totals of projected day-use at Cooper Lake. These totals for 2000, 2010, 2020, and 2030 are shown on tables 62, 63, 64, and 65, respectively.

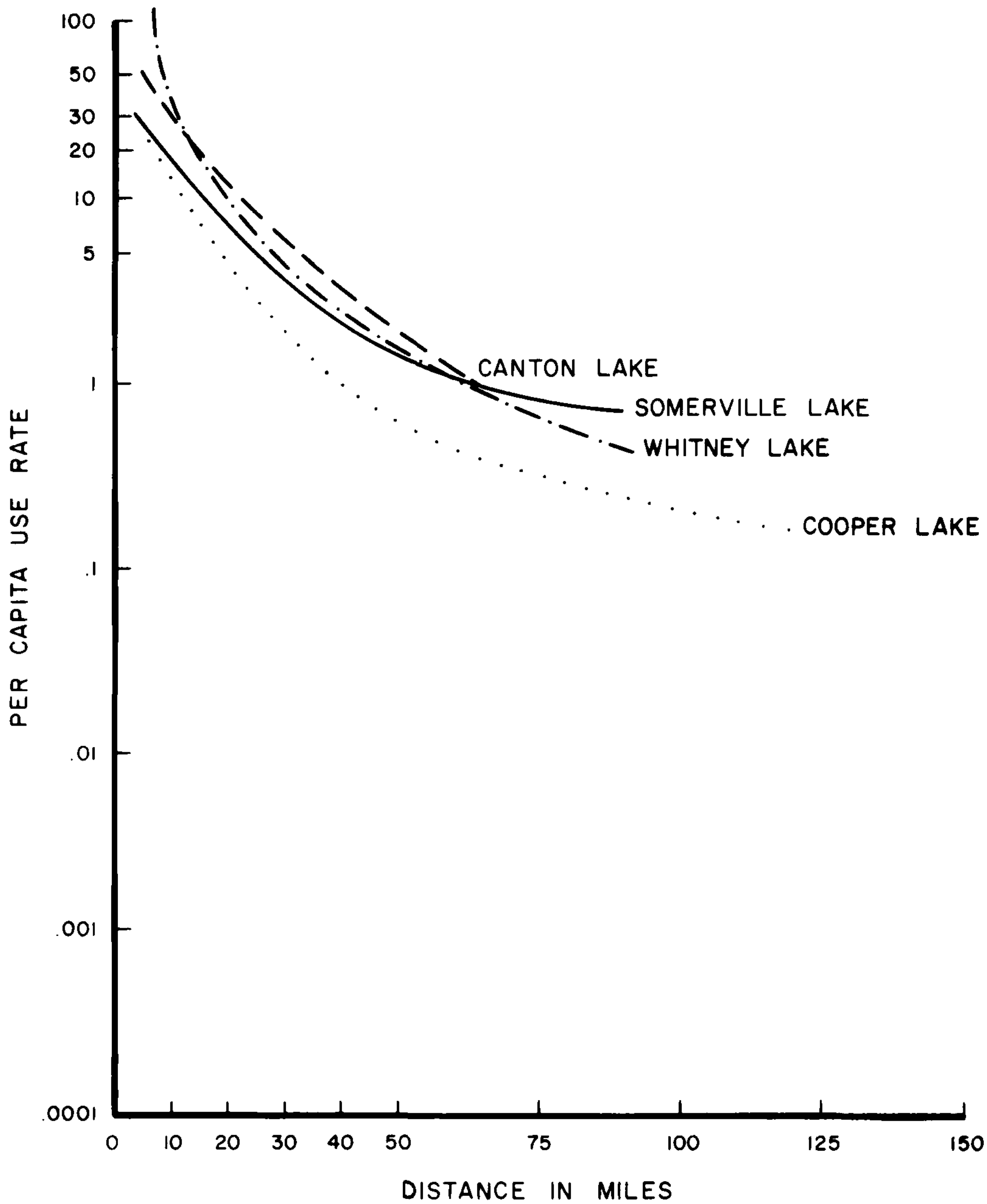

FIGURE 9 - SIMILAR PROJECTS, PER CAPITA USE RATES

TABLE 60

PROJECTED PROJECT RECREATION USE (1990)

Zone	County	Roadway Miles to Population Centroid	Per Capita Use Rate	1990 Population	Annual Use
I(0-10 Mi)	Delta	5	25.00	4,500	112,500
II(11-20 Mi)	Hopkins	17	5.50	25,900	142,450
III(21-30 Mi)	Lamar	26	2.75	43,476	119,559
IV(31-40 Mi)	Hunt	34	1.50	54,100	81,150
	Rains	38	1.20	4,400	5,280
V(41-50 Mi)	Franklin	43	.90	5,900	5,310
	Wood	45	.80	19,800	15,840
VI(51-75 Mi)	Red River	51	.60	15,442	9,265
	Rockwell	52	.57	20,500	11,685
	Titus	54	.50	16,700	8,350
	Fannin	57	.48	25,200	12,096
	Van Zandt	62	.43	24,400	10,492
	Camp	67	.35	8,100	2,835
	Collin	67	.35	211,000	73,850
	Morris	69	.33	13,300	4,389
VII(76-100 Mi)	Kaufman	77	.30	45,600	13,680
	Upshur	78	.28	24,000	6,720
	Dallas	90	.23	1,773,200	407,836
Mkt Area Day Use (90%)					1,044,095
Total Day Use (100%)					1,160,106
Camping & Overnight (18%)					208,819
Total Visitation					1,368,926
Rounded					1,369,000

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TABLE 62

(PROJECTED PROJECT RECREATION USE (2000)

Zone	County	Roadway Miles to Population Centroid	Per Capita Use Rate	2000 Population	Annual Use
I(0-10 Mi)	Delta	5	28.50	4,400	125,400
II(11-20 Mi)	Hopkins	17	6.27	29,700	186,219
III(21-30 Mi)	Lamar	26	3.14	48,770	153,138
IV(31-40 Mi)	Hunt	34	1.71	57,800	98,838
	Rains	38	1.38	4,700	6,486
V(41-50 Mi)	Franklin	43	1.03	6,100	6,283
	Wood	45	.91	19,700	17,927
VI(51-75 Mi)	Red River	51	.68	16,281	11,071
	Rockwell	52	.65	27,000	17,550
	Titus	54	.57	16,200	9,234
	Fannin	57	.55	26,400	14,520
	Van Zandt	62	.49	25,500	12,495
	Camp	67	.40	7,900	3,160
	Collin	67	.40	283,600	113,440
	Morris	69	.38	12,900	4,902
VII(76-100 Mi)	Kaufman	77	.34	52,400	17,816
	Upshur	78	.32	24,400	7,808
	Dallas	90	.26	1,995,000	518,700
Mkt Area Day Use	(90%)				1,324,987
Total Day Use	(100%)				1,472,208
Camping & Overnight	(18%)				264,997
Total Visitation					1,737,205
Rounded					1,737,000

TABLE 63

PROJECTED PROJECT RECREATION USE (2010)

Zone	County	Roadway Miles to Population Centroid	Per Capita Use Rate	2010 Population	Annual Use
I(0-10 Mi)	Delta	5	31.75	4,400	139,700
II(11-20 Mi)	Hopkins	17	6.99	30,400	212,496
III(21-30 Mi)	Lamar	26	3.49	54,300	189,507
IV(31-40 Mi)	Hunt	34	1.91	63,800	121,858
	Rains	38	1.32	4,800	7,296
V(41-50 Mi)	Franklin	43	1.14	6,100	6,954
	Wood	45	1.02	19,000	19,380
VI(51-75 Mi)	Red River	51	.76	17,400	13,224
	Rockwall	52	.72	30,100	21,672
	Titus	54	.64	17,200	11,008
	Fannin	57	.61	28,200	17,202
	Van Zandt	62	.55	26,800	14,740
	Camp	67	.45	7,600	3,420
	Collin	67	.45	316,200	142,290
	Morris	69	.42	12,400	5,208
VII(76-100 Mi)	Kaufman	77	.38	57,600	21,880
	Upshur	78	.36	25,000	9,000
	Dallas	90	.29	2,192,100	635,709
Mkt Area Day Use	(90%)				1,592,544
Total Day Use	(100%)				1,769,493
Camping & Overnight	(18%)				318,509
Total Visitation					2,088,002
Rounded					2,088,000

TABLE 64

PROJECTED PROJECT RECREATION USE (2020)

Zone	County	Roadway Miles to Population Centroid	Per Capita Use Rate	2020 Population	Annual Use
I(0-10 Mi)	Delta	5	34.50	4,400	151,800
II(11-20 Mi)	Hopkins	17	7.59	31,200	236,808
III(21-30 Mi)	Lamar	26	3.80	60,900	231,420
IV(31-40 Mi)	Hunt	34	2.07	69,800	144,486
	Rains	38	1.66	5,000	8,800
V(41-50 Mi)	Franklin	43	1.24	6,100	7,564
	Wood	45	1.10	18,300	20,130
VI(51-75 Mi)	Red River	51	.83	19,100	15,853
	Rockwall	52	.79	33,600	26,544
	Titus	54	.69	18,100	12,489
	Fannin	57	.66	30,500	20,130
	Van Zandt	62	.59	28,100	16,579
	Camp	67	.48	7,210	3,461
	Collin	67	.48	352,600	169,248
	Morris	69	.46	11,900	5,474
VII(76-100 Mi)	Kaufman	77	.41	63,300	25,953
	Upshur	78	.39	25,400	9,906
	Dallas	90	.32	2,408,300	770,656
Mkt Area Day Use	(90%)				1,876,801
Total Day Use	(100%)				2,085,334
Camping & Overnight	(18%)				375,360
Total Visitation					2,460,694
Rounded					2,461,000

TABLE 65

PROJECTED PROJECT RECREATION USE (2030)

Zone	County	Roadway Miles to Population Centroid	Per Capita Use Rate	2030 Population	Annual Use
I(0-10 Mi)	Delta	5	36.75	4,300	158,025
II(11-20 Mi)	Hopkins	17	8.09	32,400	262,116
III(21-30 Mi)	Lamar	26	4.04	68,400	276,336
IV(31-40 Mi)	Hunt	34	2.21	76,700	169,705
	Rains	38	1.76	5,100	8,976
V(41-50 Mi)	Franklin	43	1.33	6,200	8,246
	Wood	45	1.18	18,000	21,240
VI(51-75 Mi)	Red River	51	.89	21,400	19,046
	Rockwall	52	.84	37,400	31,460
	Titus	54	.74	18,800	13,912
	Fannin	57	.71	33,000	23,430
	Van Zandt	62	.64	28,900	18,496
	Camp	67	.52	7,100	3,692
	Collin	67	.52	393,100	204,412
	Morris	69	.49	11,400	5,586
VII(76-100 Mi)	Kaufman	77	.44	69,600	30,624
	Upshur	78	.41	26,000	10,660
	Dallas	90	.34	2,646,000	899,640
Mkt Area Day Use	(90%)				2,165,605
Total Day Use	(100%)				2,406,227
Camping & Overnight	(18%)				433,121
Total Visitation					2,839,348
Rounded					2,839,000

(4) Optimum capacity (optimum use). Optimum capacity is a measure of project capability. It is based on many of the physical and environmental resource factors affecting the project but must also consider population in the market area, access to the project, and user needs and preferences. Standards for maximum crowding in the project must be determined to conform with optimum visitation criteria which have been established. For lakes, these standards are keyed to a maximum boat density desirable for the project. The following computations were used to obtain the optimum use for Cooper Lake.

16,556 water acres* ÷ 5.0 acres/boat = 3,311 boats on lake at one time.

3,311 x 2 (1/2 boats active) = 6,622 boats (total boats).

6,622 x 3 persons per boat = 19,866 persons on lake at one time.

19,866 x 2 (1:1 ratio of the number of land users compared to the number of water users) = 39,732 design day load.

39,732 x 26 weekend days = 1,033,032 summer weekend users ÷ 60 summer weekend use rate = 1,721,720 summer visitation ÷ .51 summer visitation rate = 3,375,921 optimum use. Rounded to 3,376,000.

* The water acres represent the average surface acreage during the prime recreation season (June, July, and August).

Many features of a lake site can also affect recreation potential. This figure (3,376,000) is a reflection of the aspects of size, location, sustained ecological balance, and other characteristics of the project including but not limited to topography, soil, vegetation, accessibility, climate, selection of recreation areas, and water quality. It must be recognized that the optimum capacity reflects only the ability of the project to meet projected actual use, not the potential needs.

h. Recreation Facilities Analysis. The summer weekend day is the basis for estimating the land required, and the quantity and type of recreational facilities needed to adequately serve the recreational users of the project. Normal summer weekend day use of the project, expressed in recreation days was determined by the following procedures. A recreation-day is a standard unit of use consisting of a visit by one individual to a recreation development or area for recreational purposes during any reasonable portion of all of a 24-hour period.

(1) Estimate the percentage of annual attendance which occurs in the months of June, July, and August (13-week summer base). Determine the summer attendance and divide the total of 26 to arrive at a normal summer weekend day visitation. It was assumed that the visitation was equally distributed between Saturday and Sunday.

(2) The summer weekend day use in recreation days was calculated by multiplying the normal summer weekend day visitation by the weekend percentage of participants in each activity.

The recreation facilities analysis in tables 66 and 67 was used to determine the recreation facilities required to support the initial and optimum recreation use.

Application of the facility supply criteria to the normal summer weekend day use for the initial and optimum attendance yields the requirements as shown in table 68.

TABLE 68

SUMMARY OF
INITIAL AND OPTIMUM FACILITY REQUIREMENTS

Facility	Initial Requirements (1990)	Optimum Requirements (2030)
Picnic units	215	446
Group picnic shelters	6	12
Camp units	580	1,203
Camper service building	6	12
Sanitary dump station	3	6
Boat ramps (lanes)	18	37
Swimming beach (acres)	1.18	2.46
Beach change shelters	9	18
Restrooms - WB/showers	12	24
Restrooms - WB	6	15

TABLE 66

RECREATION ANALYSIS
COOPER LAKE (INITIAL)

Total annual attendance: 1,369,000 (1990)

Design day load

1,369,000 total annual attendance x .51 visits during summer months x .60 which occurs on weekends = 418,914 total number of weekend users. Total number of weekend users ÷ 26 weekend days = 16,112 design day load

Picnicking

Design day load x .20 of total are picnickers = number of picnickers
Number of picnickers x .40 of picnickers requiring facilities = number of picnickers requiring facilities
Number of picnickers requiring facilities ÷ turnover rate of 2 ÷ 3 persons per vehicle = 2.5 picnic units required

Camping

Design day load x .18 of total are campers = number of campers
Number of campers ÷ 5 persons per campsite = 580 camping units required

Boat ramps

Design day load ÷ load factor of 3 = number of vehicles
Number of vehicles x .20 of vehicles with boats = number of boats
Number of boats ÷ 60 launchings per day = i8 boat launching ramps required

Beaches

Design day load x .32 swimmers = number of swimmers
Number of swimmers x .60 swimmers on beach = number of beach users
Number of beach users ÷ turnover rate of 3 = number of users on beach at any one time
Number of users on beach at same time x 50 square feet of beach per person = 1.18 acres of land area required for sand beach

Number of swimmers x .30 are swimmers in water = number of swimmers in water
Number of swimmers in water ÷ turnover rate of 3 = number of swimmers in the water at any one time
Number of swimmers in the water at any one time x 100 square feet of water surface per user = 1.18 acres water surface required.

10% of swimmers need no additional land.

TABLE 67

RECREATION ANALYSIS
COOPER LAKE (OPTIMUM)

Total annual attendance: 2,839,000

Design day load

2,839,000 total annual attendance x .51 visits during summer months x .60 which occurs on weekends = 868,734 total number of weekend users

Total number of weekend users ÷ 26 weekend days = 33,413 design day load

Picnicking

Design day load x .20 of total are picnickers = number of picnicers

No. of picnickers x .40 of picnickers requiring facilities = number of picnickers requiring facilities

No. of picnickers requiring facilities ÷ turnover rate of 2 ÷ 3 persons per vehicle = 446 picnic units required.

Camping

Design day load x .18 of total are campers = number of campers

No. of campers ÷ 5 persons per campsite = 1,203 camping units required

Boat ramps

Design day load ÷ load factor of 3 = number of vehicles

No. of vehicles x .20 of vehicles with boats = number of boats

No. of boats ÷ 60 launchings per day = 37 boat launching ramps required

Beaches

Design day load x .32 swimmers = number of swimmers

No. of swimmers x .60 swimmers on beach = number of beach users

No. of beach users ÷ turnover rate of 3 = number of users on beach at any one time

No. of users on beach at same time x 50 square feet of beach per person = 2.46 acres of land area required for sand beach

No. of swimmers x .30 are swimmers in water = number of swimmers in water

No. of swimmers in water ÷ turnover rate of 3 = number of swimmers in the water at any one time

No. of swimmers in the water at any one time x 100 square feet of water surface per user = 2.46 acres water surface required.

10% of swimmers need no additional land.

i. Recreational Land Requirements. Land requirements for park development are based on the optimum recreational facility development with allowances for undevelopable park land area to serve as buffer area, green space, and preservation of the parklike atmosphere to assure the enhancement of the recreational experience. Lane requirements are determinėd in the following paragraphs.

(1) Parks. Considering the extent of the shoreline, operation and maintenance efficiency, existing highway circulation as well as the recreational resources of the proposed project, seven parks are necessary for the optimum recreational development of the Cooper project.

(2) Picnicking. Optimum picnicking development includes 446 picnic units and 12 group picnic shelters. Approximately 1/4 of an acre of suitable park land is required for the development of a picnic shelter. Therefore, approximately 130 acres will be required for the siting of picnicking facilities.

(3) Camping. Optimum camping development consists of campgrounds in seven parks containing 1,203 campsites, consisting of singular, family, multiple-family, and group facilities, with some 24 waterborne restrooms with showers and 12 campers washhouses necessary to meet the needs of the normal summer weekend day. Carrying capacity of the land resource and maintenance of the desired setting to achieve a high value camping experience, requires that the camping facility concentration not exceed three developed campsites per acre. Approximately 1-1/2 acres are required for the siting of a waterborne restroom with showers or washhouse. Therefore, some 455 acres of developable park lands will be required for adequate campground development.

(4) Boat launching. Optimum boat launching development will require a total of 10 boat launching complexes containing 37 lanes. Each complex will require some 10 acres each. Therefore, 100 acres will be required for this type of facility.

(5) Playgrounds. Two 10-acre sites will be required in each of the seven parks for the development of a playground. The playgrounds will contain slides, swing sets, etc. A total of 140 acres will be required for this purpose.

(6) Commercial. Commercial development of marinas will necessitate the commitment of a suitable lease site in three parks. The requirements for such a development should not exceed approximately 20 acres of suitable shoreline lands in each park or a total of 60 acres.

(7) Roads. Construction of roads and parking areas for construction of recreational facilities will require commitment of approximately 300 acres.

(8) Additional land requirements. Experience has shown that about 50 percent of available park lands are suitable for intensive

development and that the remaining land is best utilized for buffers to assure activity separation and a means of enhancing the outdoor recreation experience due to preservation of the environmental integrity of the park land and shoreline. Since approximately 1,185 acres will be required for intensive recreational development, there will be a need for an additional 1,185 acres for a total of 2,370 acres required in seven park sites, most of which must be above the top of the flood control pool.

j. Plan for Recreational Development. Cooper Lake will impound a lake with a conservation pool of 19,305 acres. The lake will create a resource capable of supplying opportunities for a wide variety of high quality, water-oriented recreational experience. Lands acquired for project purposes will permit public access to the shoreline and also serve to discourage encroachment of the natural setting of the shoreline areas. Lands acquired for recreation develcpment will assure a balance of the land and water resources. Pool releases will provide flows of suitable quantity and quality to sustain and enhance the downstream fishery. Initial development consists of construction in two parks and optimum development includes construction in five additional parks.

Since the Cooper Lake was authorized prior to the enactment of the Federal Water Project Recreation Act of 1965, Public Law 89-72, recreation at the project is being provided pursuant to Section 4 of the 1944 Flood Control Act, Public Law 78-534. However, there have been several policy determinations as to the applicability of the cost sharing provisions of PL 89-72 to pre-1966 project authorizations. Accordingly, the initial recreational development at Cooper Lake can be provided at 100 percent Federal cost but would require cost sharing for all planned future development. Consequently, this plan will only address the plan of development and the cost and benefits for the initial development.

The general location of the sites selected for public use is shown on plate C. Acreage data applicable to each site are shown in table 69.

This plan recommends a balanced approach to recreation that offers the greatest variety of outdoor recreation experiences within the limits of the recreational resources and the project's authorized purposes.

The plan recommends two high intensity use areas. In these parks, primary emphasis will be given to providing the optimum number of recreational facilities for the continued enjoyment and maximum sustained use by the visiting public consistent with the carrying capability and the esthetic and biological values. The facilities developed will include, but not be limited to, roads, parking areas, launching ramps, sanitary facilities, water supply facilities, and camping and picnic areas. South Sulphur and Doctors Creek Parks have been selected to be developed as intensive recreation parks.

TABLE 69

DATA APPLICABLE TO EACH SITE PROPOSED FOR PUBLIC USE AT COOPER LAKE

Area	Acreage: Above Conservation Pool, Elev 440.0 msl	Acreage: Required for Joint Project Purposes	Acreage: Acquired for Public Use
South Sulphur Park	2,594	1,292	1,302
Chigger Creek Park	26	26	0
Middle Sulphur Park	191	191	0
Journigan Creek	118	118	0
Johns Creek Park	113	73	40
Lone Point Park	38	38	0
Doctors Creek Park	200	155	45
Total	3,280	1,893	1,387

The remaining areas will be deferred for future development.

Access will be provided to the outlet works where tailwater fishing facilities will be provided.

k. Recreation Cost. The recreation cost presented in this plan is based on development by the Corps of Engineers. The cost estimates are based on March 1980 price levels and an interest rate of 3-1/4 percent. A summary of the recreation cost is shown in table 70.

1. Recreation Benefits. Cooper Lake was authorized prior to the enactment of the Federal Water Project Recreation Act, Public Law 89-72 (1965), and therefore recreation development is being provided pursuant to Section 4 of the 1944 Flood Control Act, Public Law 78-534. The project is being planned to provide facilities to take care of the initial recreation use. No future development is planned because it would require a local cost sharing sponsor. The benefits claimed are those expected to result from the development of these initial facilities.

Benefits were calculated by assigning values to various activities in accordance with guidance contained in Supplement 1 to Senate Document 97. The methodology applied to compute estimates of the recreation benefits is summarized in the following paragraphs.

(1) Recreation use. The initial recreation use at Cooper Lake is estimated to be 1,369,000 recreation days annually. A breakdown of figures is presented in table 71 and their average annual equivalent with and without the project is shown in table 72.

TABLE 71

ESTIMATES OF ANNUAL RECREATIONAL USE
(Expressed in Recreation Days)

Feature	Initial
General Recreation	1,172,140
Sport Fishing	192,202
Sport Hunting	4,658
Total	1,369,000

(2) Summary of recreation benefits. The general recreation benefits expected to result from the development of public use facilities are based upon projected initial recreational use, and the day unit value for the activity. The initial and future fish and wildlife benefits were converted to average annual values based on an interest rate of 3-1/4 percent with a 100-year project life (1990-2089). The total average annual fish and wildlife benefits

TABLE 70

RECREATION COST - INITIAL DEVELOPMENT

Lands - public use, 1,387 acres	$ 878,000
Facilities, initial, 1,369,000 x $4.00	5,476,000
Contingencies, ± 25%	1,369,000
Engineering and design, 9.5%	650,000
Supervision and administration, 8.7%	596,000
Total	$8,969,000
Interest during construction (.0325)	291,000
Total	$9,260,000
Amortized (100 yrs) 3-1/4%, average annual cost	$ 314,000
OM&R	
OM&R	$ 330,600
Replacement (1/3 every 25 yrs) ($8,091,000)	
$2,697,000 x .44952 = $1,212,000	
$2,697,000 x .20207 = 545,000	
$2,697,000 x .09083 = 245,000	
$2,002,000	
Average annual $2,002,000 x .033884 = $68,000	
OM&R	$ 398,600
Summary of Annual Cost:	
Facilities	$ 314,000
O&M	$ 330,600
Replacements	$ 68,000
Total	$ 712,600

TABLE 72

RECREATION AND FISH AND WILDLIFE AVERAGE ANNUAL
EQUIVALENT MAN-DAYS

Activity	Without Project	With Project	Gain or Loss
General Recreation	0	1,172,140	+1,172,140
Sport Fishing			
Stream	-2,254	0	-2,254
Lake	0	192,202	+192,202
Sport Hunting			
Deer	1,630	365	-1,265
Raccoon	702	200	-502
Rabbit	2,209	913	-1,296
Quail	616	450	-166
Squirrel	7,154	1,739	-5,415
Dove	160	160	0
Coyote	742	505	-237
Fox	286	326	+40

NOTE: The man-days for fish and wildlife are based on U.S. Fish and Wildlife Service planning aid data provided October 16, 1980.

consists of the initial benefit plus the discounted future benefits. Table 73 summarizes the unit values used to compute the recreation benefits. A summary of the average annual equivalent values is presented in table 74.

Recommended Mitigation Features

The following discussion on the fish and wildlife mitigation plan is summarized principally from information presented in appendix B.

a. Terrestrial. A specific plan to mitigate net adverse fish and wildlife losses was formulated for the Reservoir Only plan based on recommendations of the USFWS by Planning Aid Letter dated 19 August 1980. For this plan, the USFWS recommended acquisition and management of a 33,400 acre tract of land upstream of Wright Patman Lake, along White Oak Creek. Based on a habitat evaluation procedure analysis, this area would fully compensate for all habitats adversely impacted by the project.

The recommendation of the USFWS to acquire and manage the White Oak Creek area was partially accepted. Acquisition of the 33,400 acre full compensation area could not be justified. The acquisition and management of lands to compensate principally for bottomland hardwood losses is justified, however, as this is a recognized significant habitat, and is decreasing in quantity. The acquisition, development, and management of a tract of land within the compensation area recommended by USFWS, which will compensate primarily for bottomland hardwood losses and incidentally will contribute to offsetting net adverse losses in productivity of semiwooded habitat, is considered justifiable. This tract consists of about 25,500 acres, including 20,300 acres of bottomland hardwood habitat. This area, shown on plate D, will be fenced, and initial development will be applied to create a wildlife management area to offset bottomland hardwood losses due to the implementation of the Reservoir Only Cooper Lake and Channels project. Operation and maintenance will be budgeted to maintain the wildlife management area.

In addition to the above mitigation area, the following actions will be undertaken to further compensate for net adverse terrestrial wildlife losses, including semiwooded habitat losses.

- A 751 acre tract of bottomland wooded habitat between Cooper Dam and Highway 19/154 will be acquired in fee. The majority of this area is flooded with the 3,000 cfs maximum release and a flowage easement is required. The Corps proposes to acquire the land in fee rather than flowage easement so that full public wildlife value can be developed, and trail systems can be implemented within the area.

TABLE 73

UNIT VALUES

Activity	Value
General Recreation	$1.50
Stream Fishing	1.50
Lake Fishing	1.50
Deer Hunting	6.00
Raccoon Hunting	2.00
Rabbit Hunting	2.00
Quail Hunting	2.00
Squirrel Hunting	2.00
Dove Hunting	2.00
Coyote Hunting	2.00
Fox Hunting	2.00

TABLE 74

RECREATION AND FISH AND WILDLIFE BENEFITS
(Average Annual Equivalent Values)

Activity	Without Project	With Project	Gain or Loss
General Recreation	$ 0	$1,758,210	$+1,758,210
Sport Fishing			
Stream	3,381	0	-3,381
Lake	0	288,303	+288,303
Sport Hunting			
Deer	9,780	2,190	-7,590
Raccoon	1,404	400	-1,004
Rabbit	4,418	1,826	-2,592
Quail	1,232	900	-332
Squirrel	14,308	3,478	-10,830
Dove	320	320	0
Coyote	1,484	1,010	-474
Fox	572	652	+80

SUMMARY

		Rounded To
General Recreation	$1,758,210	$1,758,000
Fishing	285,072	285,000
Hunting & Trapping		
Without mitigation	-27,558	-27,600
With mitigation	0	0 *
Commercial Fishing	29,560	30,000

* Implementation of the Corps terrestrial mitigation plan for the Reservoir Only selected plan is considered to offset the monetary wildlife losses.

- o During master planning for recreation development and land resource management on lands acquired for Cooper Lake, all perimeter lands not required for project operation or immediate recreation development will be designated for wildlife management purposes, or in the case of recreation land, interim wildlife management. Vegetative plantings and land management practices will be applied to these lands during construction to offset wildlife losses greater than natural succession processes would.

- o An initial development cost for wildlife habitat development of perimeter lands will be budgeted. Operation, maintenance, and management of these project lands will also be budgeted.

Table 75 presents cost analysis of the Corps recommended terrestrial habitat mitigation plan for the supplemental EIS selected plan (Reservoir Only).

b. Aquatic. By Planning Aid Letter dated August 19, 1980, and in the current Coordination Act Report, the USFWS recommended a continuous downstream flow release schedule from Cooper Dam (after normal operating pool is reached) of 45 cfs for the months of September through February, 50 cfs for the months of March through April, and 30 cfs for the months of May through August. This schedule was recommended for an average water year, with two contingency plans reducing the recommended downstream releases during drought cycles. The USFWS also evaluated the Corps proposed operating plan which provides for a 5 cfs continuous low flow release when there are no flood pool releases.

As with the terrestrial plan, the USFWS recommended downstream flow releases were only partially accepted. Full rationale and discussion for rejection of continuous downstream releases is presented in appendix B. Primarily these relate to a determination that the requested flows are more appropriately defined as optimum releases rather than mitigation for identified stream losses, the limited alternatives available and constraints with regard to water supply contracts and water rights for Cooper Lake, and the existing type and quality of the stream fishery affected by Cooper Lake balanced against the lake fishery gains.

The following aquatic (stream) mitigation features will be included in the Reservoir Only selected plan.

- o Public access to stream fishery be provided on lands acquired for Cooper Lake, including stream area downstream from the dam to Highway 19/154.

- o Public access to stream fishery be provided on all lands acquired for terrestrial habitat mitigation.

TABLE 75

COST ANALYSIS - TERRESTRIAL MITIGATION PLAN

(SUPPLEMENTAL EIS RECOMMENDED PLAN)

(1980 Price Levels)

Habitat Type	Acres Required	Cost/ Acre	Total Land Cost ($1000)	Development Cost/Acre	Development Cost ($1000)
BLHW	20,345	200	4,069.0	96	1,953.1
OPEN/SW	5,189	300	1,556.7	0	0
TOTAL	25,534		5,625.7		1,953.1

MITIGATION AREA - WHITE OAK CREEK	
Costs	($1,000)
Lands	5,625.7
Damages and Contingencies	2,419.1
Administrative	104.6
Total Acquisition Cost	8,149.4
Total Development Costs	1,953.1
Fencing (60 miles x $16,000/mile)	960.0
Subtotal	11,062.5
E&D	364.1
S&A	196.7
Total First Cost	11,623.3
Interest and Amortization	393.8
O&M ($5/acre/year)	127.7
Subtotal Average Annual Charges - Mitigation Area	(521.5)
PROJECT LANDS - COOPER LAKE	
Costs	
Incremental Acquisition Cost (downstream 3,000 cfs release areas) 1/	265.0
Development Costs (revegetation of project lands)	600.0
Subtotal	865.0
E&D	75.0
S&A	51.9
Total First Cost	991.9
Interest and Amortization	33.6
O&M ($5/acre/year x 7,200 acres)	36.0
Subtotal Average Annual Charges - Project Lands, Mitigation	(69.6)
TOTAL AVERAGE ANNUAL CHARGES - TERRESTRIAL MITIGATION PLAN	591.1

1/ Cost difference between purchasing flowage easement on 641 acres downstream of dam, and purchase in fee of 751 acres.

- o The regulating plan for Cooper Lake will provide for reduced discharges whenever operating within the lower 5 percent (1/3 foot) of the flood pool. Releases from this retained flood storage will be made at the rate recommended by USFWS until the lake is again at supply pool or above the 5 percent level of the flood pool. A 5 cfs constant low flow will be maintained downstream whenever the lake elevation is within the water supply pool. When the lake is above the 5 percent level of the flood pool, controlled releases will be 3,000 cfs as designed.

Plan Evaluation Under 1980 Conditions and Prices

As a final analysis, the Supplemental EIS Recommended Plan, including fish and wildlife mitigation measures, was analyzed under 1980 conditions and prices. A current land use study was performed using aerial photography taken in March 1980 and supplemented by field verifications. March 1980 prices were applied to all benefits and costs.

a. Benefit-Cost Analysis. Average annual benefits for the Recommended Plan (Reservoir Only, including mitigation) were updated to March 1980 prices. The results are presented in section III of appendix C and are summarized in table 76.

TABLE 76

AVERAGE ANNUAL BENEFITS - SUPPLEMENTAL EIS RECOMMENDED PLAN
(March 1980 prices; 3-1/4 percent interest;
100-year period of analysis)

FLOOD CONTROL	
Flood Damage Reduction	
Agricultural	$ 379,800
Nonagricultural	286,000
Intensification	16,900
Storage Exchange	139,000
Subtotal - Flood Control	$ 821,700
WATER SUPPLY	$4,412,600
RECREATION	1,758,200
FISH AND WILDLIFE	315,000 *
AREA REDEVELOPMENT	0
Total Average Annual Benefits	$7,307,500

* Net sport hunting and trapping losses from Reservoir Only in the amount of $27,600 are considered offset with inclusion of the mitigation plan.

Average annual costs for the Supplemental EIS Recommended Plan (Reservoir Only, including mitigation) at the March 1980 price level are detailed in table 77.

From table 76 and table 77, the benefit-cost ratio at March 1980 conditions and prices is 1.46 ($7,307,500/$4,993,400). Average annual net benefits are $2,314,100.

b. Environmental Analysis. Environmental impacts for the Reservoir Only plan, including mitigation, are essentially the same under 1980 land use conditions as detailed in Section V of the Supplemental EIS and Section VI of this appendix. Between 1974 and 1980, there have been no identified major changes in overall flood plain or project land use which would significantly change quantity or quality of environment parameters. About 1,200 acres of bottomland wooded habitat along the Sulphur River near Highway 37 and adjacent to existing (status quo) levee 3RS have been cleared and put into crop production. An after-the-fact Section 404 regulatory permit is being processed on this clearing operation due to part of the area being determined to be wetlands. There is additional landowner interest in pursuing clearing and levee construction in at least three other sites within wetland areas of the Sulphur River flood plain. Each of these proposed actions, if pursued by the landowners, will affect wetlands and require application by the landowner and review by the Corps of Engineers in accordance with the Section 404 permit program. The outcome of these applications is unknown at this time. The actual evidence of clearing in the Sulphur River flood plain between 1974 and 1980 is not deemed significant enough to warrant a change in the projected future of bottomland hardwoods used in the 1974 analysis.

Cultural resources, fisheries and wildlife habitat, water or air quality, endangered species, or wetlands impacted by the selected plan are the same for 1980. The value of potential commercial fishing in Cooper Lake has increased slightly which is adjusted to 1980 price levels in section III of appendix C. Other benefit values for sport hunting, fishing, and recreation have not changed since these are based on Supplement 1 to Senate Document 97. The estimated recreational use of Cooper Lake based on a 1980 reanalysis using different "similar projects" than used in the 1974 analysis resulted in an increased recreation use estimate (1,369,000) than that claimed for Cooper Lake under 1974 conditions in the final EIS. This estimate, however, is only slightly less than the 1,508,000 million recreation day estimate developed using the same procedure in the 1976 draft EIS, but not used in alternatives evaluation in the final EIS or supplemental EIS.

TABLE 77

FIRST COST AND AVERAGE ANNUAL CHARGES
SUPPLEMENTAL EIS RECOMMENDED PLAN
(March 1980 prices; 3-1/4 percent interest;
100-year period of analysis)

FIRST COST	
Cooper Lake and Levee 4RSS Spur	
01 Lands and Damages	$ 19,904,000
02 Relocations	3,778,000
03 Reservoir	4,825,000
04 Dam	48,371,000
08 Roads	3,305,000
11 Levees	380,000
14 Recreation Facilities	6,440,000
19 Buildings, Grounds, and Utilities	792,000
20 Permanent Operating Equipment	472,000
Subtotal	$ 88,267,000
30 Engineering and Design	$ 6,016,000
31 Supervision and Administration	5,143,000
Subtotal	$ 99,426,000
Downstream Flowage Easement	$ 125,000
Total - Cooper Lake and Levee 4RSS Spur	$ 99,551,000
Fish and Wildlife Mitigation Measures	
White Oak Creek Area	
Lands and Damages	$ 8,150,000
Development and Fencing	2,913,000
Subtotal	$ 11,063,000
Engineering and Design	$ 364,000
Supervision and Administration	197,000
Total	$ 11,624,000
Cooper Lake Area	
Incremental Acquisition of Downstream Area	$ 265,000
Development (revegetation of project lands)	600,000
Subtotal	$ 865,000
Engineering and Design	$ 75,000
Supervision and Administration	52,000
Total	$ 992,000
Total - Fish and Wildlife Mitigation Measures	$ 12,616,000
TOTAL FIRST COST	$112,167,000
INVESTMENT	
Cooper Lake and Levee 4RSS Spur	
Total First Cost	$ 99,551,000
Interest During Construction (4 yrs at 3-1/4%)	6,471,000
Total - Cooper Lake and Levee 4RSS Spur	$106,022,000

TABLE 77 - FIRST COST AND AVERAGE ANNUAL CHARGES - SUPPLEMENTAL EIS RECOMMENDED PLAN (continuation)

INVESTMENT (continuation)	
Fish and Wildlife Mitigation Measures	
Total First Cost	$ 12,616,000
Interest During Construction	0
Total - Fish and Wildlife Mitigation Measures	$ 12,616,000
TOTAL INVESTMENT	$118,638,000
AVERAGE ANNUAL CHARGES	
Cooper Lake and Levee 4RSS Spur	
Interest and Amortization	$ 3,592,400
Operation and Maintenance	740,900
Major Replacements	69,000
Total - Cooper Lake and Levee 4RSS Spur	$ 4,402,300
Fish and Wildlife Mitigation Measures	
White Oak Creek Area	
Interest and Amortization	$ 393,800
Operation and Maintenance	127,700
Total	$ 521,500
Cooper Lake Area	
Interest and Amortization	$ 33,600
Operation and Maintenance	36,000
Total	$ 69,600
Total - Fish and Wildlife Mitigation Measures	$ 591,100
TOTAL AVERAGE ANNUAL CHARGES	$ 4,993,400

APPENDIX D

EXHIBIT 1

NORTH TEXAS MUNICIPAL WATER DISTRICT

P. O. DRAWER C
WYLIE, TEXAS 75098
PHONE NO. 442-2217

REGIONAL SERVICE THROUGH UNITY

June 20, 1980

Colonel Donald J. Palladino
Department of the Army
Fort Worth District
Corps of Engineers
P. O. Box 17300
Fort Worth, Texas 76102

RE: Comments on Draft Cooper
Lake Water Supply Study

Dear Colonel Palladino:

The NTMWD has reviewed the preliminary draft Cooper Lake Water Supply Study dated May 15, 1980. This letter will serve as the Official Comment by the NTMWD on this Study.

As you are aware the North Texas Municipal Water District was created due to the water shortage in the Dallas Metropolitan area in the early fifties. During the construction of the initial NTMWD facilities the drought of record for the area occurred between 1953 and 1957. These factors, plus the responsibility to meet the growing demand of the 27 member and customer municipalities in the service area of the NTMWD, requires a realistic approach to planning rather than the academic methodology utilized in the study. The projections of the North Texas Municipal Water District reflect an average need by 1985 of 104.76 MGD, and 158.47 MGD by the year 2000 which compares with 91.6 MGD in 1985 and 119.6 MGD in 2000 by your study. NTMWD projections are in line with historical growth rates and continued utilization of a conservation ethic for the benefit of the citizens in the area.

The NTMWD working with the Federal and State Agencies many years ago started a policy of conservation by developing Lake Lavon and utilization of storage of flood waters for benefits to the citizens within a water scarce area. The efforts of the NTMWD to maintain an adequate water supply within an environment conducive to economic growth for a sustained and improved standard of living requires the construction of

additional water storage capacity along with other treatment and distribution facilities. Enclosed is a copy of an NTMWD Official Bond Statement on the sale of $11,755,000 of Water System Revenue Bonds sold in the open market to the First Boston Corporation on May 20, 1980. This document reflects the activity of the NTMWD and our commitment to meet the needs for the citizens in the area. In 1979 the NTMWD sold a 16.4 million dollar Revenue Bond Issue for Water System Improvements. Additional raw water is a necessity to continue the well being of the area, therefore, your findings of adequate need was welcomed even though, in our opinion, these methodologies could result in a shortage if strictly implemented.

Also, enclosed for your general information is a copy of the NTMWD Newsletter dated June 1980 and we call to your attention that on Page 4 an NTMWD Water Consumption Report for January thru May for the years 1978 - 1979 - 1980 shows the continued growth factors. As can be noted individual variations between the Cities is a result of the individual nature of the communities, weather conditions in the immediate area, and other factors beyond the control of the municipalities; however, the overall trend is continuingly upward even in an economic recession. All of these factors are being stressed to emphasize the fact that the dynamic growth in the Dallas - Fort Worth Metroplex is based on many factors, but one which is a necessity is a continuing supply of adequate and dependable water. When the responsibility for water rests on an individual agency it is necessary to think of the human suffering when water must be rationed, lawns burned, and an overall reduction in the standard of living resulting from reduced economic activity; that has been caused by inadequte planning on the part of governmental agencies.

As a last point of interest, which appears to conflict with the report, is that during drought conditions individual per capita water needs increase not decrease. This is brought about by the need for the citizen to change and wash clothes more frequently, bathe on a more regular basis, and consume water in greater quantities. This, in turn, creates greater demands when you have the greatest losses from evaporation

and absorbtion in the system. The study appears to use average data for development of projected need, rather than the system stress during drought conditions. The NTMWD has a need for all of the water supply that could be impounded in the Cooper Project but realizes the necessity of sharing these vital resources with other entities where the need is present. It should be apparent to all from a review, not only of your study, but the history of the Dallas-Fort Worth area, that the reality of maintaining adequate supply systems to meet human needs when resources are available is the best use of Federal, State and local funds and efforts.

As previously submitted and discussed with your office the NTMWD can provide additional data to justify a need in excess of 280.7 MGD by the year 2040. The NTMWD Staff stands ready to work with you for the development of this vital and essential reservoir project which will assist in the further enhancement of the supply capabilities for the Dallas - Fort Worth Metropolitan area, as well as, the local and rural communities surrounding the project. Thank you for the opportunity to comment.

Sincerely,

Carl W Riehn

CARL W. RIEHN

Executive Director

CWR:md
Encl.

Appendix D

Exhibit 2

WATER SUPPLY NEEDS STUDY

COOPER LAKE WATER SUPPLY STUDY

Prepared for the Fort Worth District
Corps of Engineers

by

Southwestern Division, Corps of Engineers
Dallas, Texas
April 1980

FOREWORD

The purpose of this report is to present forecasts of municipal and industrial (M&I) water requirements for potential users of water from the proposed Cooper Lake. These projected requirements are compared with current and anticipated supplies to determine whether there are any net water supply needs which could be met by Cooper Lake. The potential users are defined as those who have contracted for the lake's M&I water supply storage.

For the purposes of this study, the municipal component of water use is defined as all water supplied by a municipal system excluding water supplied for industrial purposes. The industrial component consists of all water supplied by the municipal system for manufacturing and mining activities.

Immediately following this Foreword is the Summary of the Report. The Report itself consists of three sections. The first section, entitled "The Study Area," delineates the study area and briefly describes those entities which are considered to be potential users of water for M&I purposes from Lake Cooper. The second section is entitled "Municipal and Industrial Water Requirements: Baseline Projections" and measures net water supply needs assuming that there are no conservation programs other than those currently in existence. The third section,"Municipal and Industrial Water Requirements with Conservation," measures net M&I water supply needs with conservation measures undertaken beyond those currently employed. Appendix A to this report contains a description of projection methodology. Appendix B gives projections for the City of Dallas System upon which Irving depends for its supply. Appendix C discussed historical irrigation of agricultural land in the study area.

SUMMARY

This study determines future municipal and industrial water requirements for five water supplying entities which are considered to be potential users of water from the proposed Cooper Lake. These entities are the North Texas Municipal Water District and the cities of Irving, Commerce, Cooper and Sulphur Springs. The cities of Commerce, Cooper and Sulphur Springs collectively form the Sulphur River Municipal Water District which was organized to be a purveyor of water from Cooper Lake.

Two sets of projections are made for each entity. First, baseline projections are made with the assumption that no water conservation programs are implemented beyond those currently in effect. Second, projections are made given the implementation of a conservation program which would reduce seasonal water use by 10 percent and require water saving plumbing fixtures for all new construction and replacement plumbing.

Table S-1 shows projections of net water supply needs, i.e., the excess of projected total municipal and industrial water needs over projected supplies for the five water supplying entities in the aggregate. Net needs are shown for both the baseline and the "with conservation" condition. For the baseline projections net water supply needs are projected to be 13.0 mgd in 1990 and reach 142.5 mgd by 2040. With the institution of the conservation programs net needs would range from 7.7 mgd in 1990 to 121.2 mgd in 2040.

TABLE S-1

NET WATER SUPPLY NEEDS FOR THE COOPER LAKE STUDY AREA

(Millions of Gallons Daily)

YEAR	NET NEEDS BASELINE	NET NEEDS WITH CONSERVATION
1985	-	-
1990	13.0	7.7
2000	28.6	20.5
2010	68.8	56.4
2020	89.1	73.6
2030	114.8	95.7
2040	142.6	121.2

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COOPER LAKE WATER SUPPLY STUDY

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I

THE STUDY AREA

The study area is located in Northeast Texas. Those entities located in this area which are considered to be potential users of water for M&I purposes from Cooper Lake are shown in Figure 1. The entities are the cities of Irving, Commerce, Sulphur Springs and Cooper, and the North Texas Municipal Water District (NTMWD).

The NTMWD is a quasi state agency created in 1951 by a special law passed by the State Legislature. The District served about 414,200 persons in 1977 in an area of approximately 1600 square miles located in parts of Dallas, Collin, Rockwall, and Kaufman Counties. The District's plant is located in Wylie, Texas in Collin County and provides water to 11 member cities and 18 customers entities which are smaller cities or water districts. The member cities are Farmersville, Forney, Garland, Mesquite, McKinney, Plano, Princeton, Richardson, Royce City, Rockwall and Wylie. These member cities and customers basically compose the rapidly growing eastern and northeastern sides of the Dallas metropolitan area. The rapidity of the area's growth is emphasized by the fact that the District's sales of treated water has increased from 12 million gallons daily in 1957 to 68 million gallons daily in 1979.

The City of Irving is located west of the City of Dallas in Dallas County. The 1977 population of Irving was estimated to be 105,100 persons.

The cities of Commerce, Cooper, and Sulphur Springs are located in the eastern, more rural portion of the study area. Commerce is located in Hunt County and has 9,200 inhabitants. Cooper is located in Delta County and has 2,000 inhabitants. Sulphur Springs in Hopkins County has a population of 15,900 persons in 1978. These three cities collectively form the Sulphur River Municipal Water District which was formed for the purpose of contracting for Cooper Lake Water.

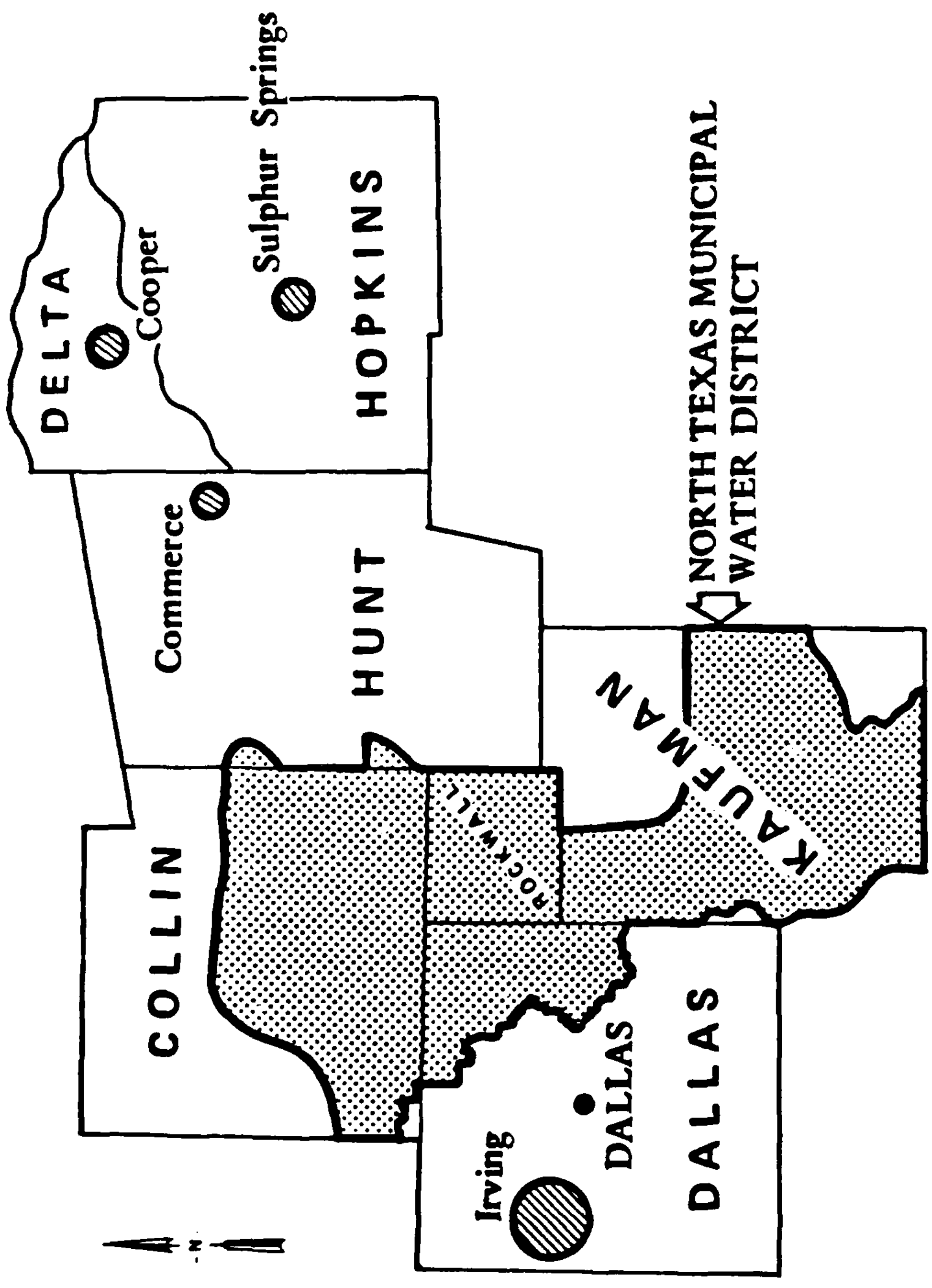

FIGURE 1. THE COOPER LAKE STUDY AREA.

II

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS:

BASELINE PROJECTIONS

North Texas Municipal Water District

In 1977 the NTMWD supplied about 62.9 million gallons a day (mgd) of water for M&I purposes. Municipal use was 56.1 mgd, for a per capita use rate of about 128 gallons per day. Industrial use amounted to about 6.8 mgd in 1977. The processing of food and kindred products with 2.5 mgd was the leading water using industrial activity followed by the production of fabricated metal products with 1.3 million gallons used daily. Water used for steam electric generation cooling accounted for 1.2 mgd of the 6.8 mgd total.

Table 1 shows projections of municipal, industrial, and total M&I water requirements for the NTMWD service area to the year 2040. As the Table indicates, total M&I water requirements are projected to increase 66 percent over the 13 year period, 1977 thru 1990, to 104.1 mgd. By the year 2040 the total M&I requirements for the District are projected to reach 193.7 mgd.

The NTMWD derives its supply of water from Lake Lavon near Wylie, Texas. The District has contracted for all of the water supply storage in the lake which has a dependable yield of 91.8 mgd.

Table 2 shows net needs and indicates that the District's supply of water will meet its needs only until about the year 1985. By the year 2000, given these baseline projections, the District's net needs are projected to amount to 27.8 mgd. The net needs in 2040 are projected to reach 101.9 mgd.

TABLE 1

BASELINE MUNICIPAL, INDUSTRIAL AND TOTAL WATER REQUIREMENTS
FOR THE NTMWD, HISTORIC AND PROJECTED YEARS

(MILLIONS OF GALLONS DAILY)

YEAR	MUNICIPAL	INDUSTRIAL	TOTAL
1977	56.1	6.8	62.9
1985	82.7	8.9	91.6
1990	94.0	10.1	104.1
2000	109.0	10.6	119.6
2010	122.0	11.0	133.0
2020	138.1	12.5	150.6
2030	155.7	14.5	170.2
2040	175.6	18.1	193.7

TABLE 2

BASELINE TOTAL M&I WATER REQUIREMENTS VS SUPPLY FOR
THE NTMWD, HISTORICAL AND PROJECTED YEARS

(MILLION OF GALLONS DAILY)

YEAR	TOTAL M&I	SUPPLY[1]	NET NEEDS
1977	62.9	91.8	--
1985	91.6	91.8	--
1990	104.1	91.8	12.3
2000	119.6	91.8	27.8
2010	133.0	91.8	41.2
2020	150.6	91.8	58.8
2030	170.2	91.8	78.4
2040	193.7	91.8	101.9

1/ Yield from Lake Lavon, the current source of supply.

Irving

The City of Irving used 16.7 mgd of water for total M&I purposes in 1977. Industrial usage was 1.0 mgd. Processors of food and kindred products were the biggest users of water for industrial purposes accounting for 50 percent of the total. Manufacturers of nonelectrical machinery accounted for 30 percent the city's industrial water use.

Much of the city's recent economic growth has been occurring in its northern portion where the rapidly growing Las Colinas Business Park is located. This Park has been expanding rapidly with distribution centers, warehousing and light manufacturing. It is not expected, however, that the type of industrial activity which will locate in the area will be heavy manufacturing which would require large amounts of water for the production processes.

Irving has two sources of water: well water and treated water from the City of Dallas. The well water is obtained from the Whalen Corporation with which the city has a ten year contract which expires in 1987. The contract which provides for a maximum of 5.76 million gallons on a given day allows for the city to purchase the wells upon expiration of the contract.

For a number of reasons, however, well water should not be considered a reliable future source for Irving. According to city officials the total dissolved solids and flourides in the water exceed the standards established by the 1974 Safe Drinking Water Act, Pl-93-523. Also the Texas Department of Water Resources (TDWR) has indicated that since 1950 extreme water levels declines of 500 to 550 feet in the Dallas-Fort Worth area has created the potential for land surface subsidence and saline water encroachment.[1]

1 Texas Department of Water Resources, Continuing Water Resources Planning and Development for Texas, Vol 2 of 2, May, 1977, P. IV-266.

In May of 1977 Irving signed a water supply contract with the City of Dallas which would enable Irving to meet its needs until 2007 when the contract expires. Projections of needs for the City of Dallas shown in Appendix B indicates that Dallas would have sufficient supplies to meet its needs until sometime between 2010 and 2020. In anticipation of this shortage, it does not seem reasonable to assume that Dallas would renew its contract with Irving after it expires.

Projections of baseline municipal, industrial and total M&I water requirements for the city of Irving are shown in Table 3. Total M&I use is projected to grow to 24.7 mgd by the year 2000 and 36.0 mgd by 2040.

Table 4 shows projections of baseline total M&I requirements and net water supply needs for the City of Irving. As indicated Irving would need a source to meet these requirements after its contract with Dallas expires. Net water supply needs would be 26.8 mgd in 2010 and reach 36.0 mgd by 2040.

TABLE 3

BASELINE MUNICIPAL, INDUSTRIAL AND TOTAL WATER REQUIREMENTS
FOR THE CITY OF IRVING, HISTORICAL AND PROJECTED YEARS

(MILLIONS OF GALLONS DAILY)

YEAR	MUNICIPAL	INDUSTRIAL	TOTAL
1977	15.7	1.0	16.7
1985	19.0	1.1	20.1
1990	20.4	1.1	21.5
2000	23.5	1.2	24.7
2010	25.6	1.2	26.8
2020	28.1	1.4	29.5
2030	30.7	1.6	32.3
2040	33.9	2.1	36.0

TABLE 4

BASELINE TOTAL M&I WATER REQUIREMENTS VS.
SUPPLY FOR THE CITY OF IRVING

(MILLIONS OF GALLONS DAILY)

YEAR	TOTAL M&I	SUPPLY	NET NEEDS
1977	16.7	(a)	-
1985	20.1	(a)	-
1990	21.5	(a)	-
2000	24.7	(a)	-
2010	26.8	(b)	26.8
2020	29.5	(b)	29.5
2030	32.3	(b)	32.3
2040	36.0	(b)	36.0

(a) Supply is from City of Dallas which according to the contract would meet Irvings needs until its expiration in 2007.

(b) Supply is zero based on expectation that Dallas, in anticipation of a water supply deficit between 2010 and 2020, would not renew its contract with Irving.

Commerce

The City of Commerce used about 1.4 mgd of water for municipal and industrial purposes in 1978. Its municipal use per capita was about 153 gallons per day and municipal use totaled 1.41 mgd. Included in this total municipal use amount is 300 thousand gallons supplied daily to East Texas State University and about 66 thousand gallons a day to North Hunt County Rural Water District. The city's only major industrial user was a producer of latex surgical gloves that required about 300 thousand gallons daily.

Table 5 shows baseline projections of municipal, industrial, and total M&I water requirements to the year 2040. Total M&I requirements are projected to increase 46 percent to 2.50 mgd by the year 2000 and more than double to 3.51 by the year 2040.

In 1977 the City of Commerce entered into a contract with the Sabine River Authority (SRA) to obtain water from Lake Tawakoni. According to the terms of the contract, the SRA will supply up to 228 million gallons per month for the first 10 years and up to 91 million gallons a month for the next 40 years. Currently, the city has a 30 mile long,14 inch pipeline from Tawokoni to Commerce. This pipeline will allow the city to receive 3 million gallons each day , although the City's treatment plant would have to be enlarged to handle the 3 mgd. The capacity of the pipeline would be adequate to handle its current needs based upon its peak day usage in July of 2.6 mgd or 1.5 times its average daily use in 1978. Based upon this ratio, the pipeline would be inadequate when the city's average needs over a one year period exceed 2.0 mgd. Therefore, in order for the city to meet all of its future needs from Tawokoni it would have to build another 30 mile pipeline parallel to the existing one.

The city, as part of its long range planning for water, has laid a 20 inch pipeline northeast to a 3 well field outside the city. The pipeline is in the

TABLE 5

BASELINE MUNICIPAL INDUSTRIAL AND TOTAL WATER REQUIREMENTS
FOR THE CITY OF COMMERCE, HISTORICAL AND PROJECTED YEARS

(MILLIONS OF GALLONS DAILY)

YEAR	MUNICIPAL	INDUSTRIAL	TOTAL
1978	1.41	.30	1.71
1985	1.72	.34	2.06
1990	1.86	.37	2.23
2000	2.12	.38	2.50
2010	2.29	.40	2.69
2020	2.40	.46	2.86
2030	2.60	.55	3.15
2040	2.75	.76	3.51

direction of the intake system which would be built on Cooper Lake. This line would have to be extended only an additional five miles to tap the supply in Cooper.

Commerce currently has seven wells. In 1978 the city obtained .85 mgd, about one half of its total requirement in that year from goundwater. Commerce is located in the Sulphur River Basin where groundwater is generally regarded as poor quality and insufficient quantity. The Texas Department of Water Resources has recommended that groundwater withdrawal throughout the Basin be reduced to arrest water level declines and potential for saline - water encroachment.[2]

Table 6 shows projected baseline, total M&I requirements for the City of Commerce compared with its supply. The supply shown is the maximum monthly amount allowed by the city's contract with the SRA to the year 2027 when the contract expires. The projected requirements are not absolutely comparable to projected supply since requirements are based on average daily use over the period of a year while supply is a daily average based on the maximum allowed per month according to the contract. Therefore, the average daily requirement the month of July because of landscape irrigation would be expected to exceed the average daily requirement figured over the entire year. In fact, in 1978, a very hot and dry year, average daily use in July exceeded average daily use over the entire year by 14 percent. If this relationship held true for the year 2020, July usage in that year would be 3.2 mgd or .2 mgd more than the amount allowed by the contract in the month of July. If the City's contract were not renewed when it expired in 2027 the city would have a net water supply need of 3.2 mgd in 2030 and 3.5 mgd in 2040.

[2] Texas Department of Water Resources, Continuing Water Resources Planning, p.IV-9.

TABLE 6

BASELINE TOTAL M&I WATER REQUIREMENTS VS SUPPLY FOR
THE CITY OF COMMERCE, HISTORICAL AND PROJECTED YEARS

(MILLIONS OF GALLONS DAILY)

YEAR	TOTAL M&I	SUPPLY 1/	NET NEEDS
1977	1.7	7.5	--
1985	2.1	7.5	--
1990	2.2	3.0	--
2000	2.5	3.0	--
2010	2.7	3.0	--
2020	2.9	3.0	--
2030	3.2	--	3.2
2040	3.5	--	3.5

1/ Numbers shown are amounts of Lake Tawokoni water available to the city according to the terms of its contract with the Sabine River Authority. The contract expires in 2027.

Cooper

The City of Cooper supplies about .35 mgd of water to its customers. Included in this amount is .08 mgd which it supplies to the Charleston Water Supply Corporation. The city supplies no significant amounts of water for industrial purposes.

The city's principal sources of supply are three city owned lakes. There is no data available on the safe yield of these lakes. During the 1971 and 1972 period the city rationed water because of the low lake levels. In the drought of 1978, the city exhausted the water supply in these lakes necessitating the construction of a waterline to Sulphur Springs.

The water transmission line from Cooper to Sulphur Springs has a maximum daily capacity of .50 mgd which would be adequate to meet the peak daily usage associated with an average daily use over the period of a year of .25 mgd. The two cities have signed a contract for delivery of the water for a period of 8 years with the anticipation of the availability of Cooper Lake water at the end of that period.

As previously mentioned groundwater throughout the Sulphur River Basin is generally of poor quality and insufficient quantity. The Texas Department of Water Resources recommends the reduction of groundwater withdrawal throughout the Basin to arrest water level declines and the potential for saline water encroachment.

Because of the poor groundwater situation the City of Cooper has filed a pre-application for funding of a county-wide water supply system in 1977 with the Ark-Tex Council of Governments and the Farmers Home Administration. Contingent upon the completion of Cooper Lake, the city would treat raw water and supply treated water to all water supplying entities in the County. The

pre-application was approved by both agencies and the City has been invited to submit a formal application for funding of the project.

The additional water supplying entities which would be expected to be served and the number of customers are shown below:

Ben Franklin W.S.C.	-	85 Meters
Enloe Lake Creek	-	158 meters
Lone Star	-	58 meters
West Delta	-	327 meters
Pecan Gap	-	240 meters
Ladonia (Fannin County)	-	825 persons

Based upon 2.45 persons per meter these entities would constitute an additional 2,952 persons above the population to which the city now supplies water. All of the above entities except Pecan Gap currently rely on goundwater as their source of supply. Pecan Gap is contemplating supplementing its small city owned reservoir with goundwater in the future.

Table 7 shows baseline projections of requirements for the City of Cooper's water system. Its current requirement of .35 mgd would increase to .72 mgd by 1990 with the addition of the customers associated with inclusion of the water supplying entities listed above. Total requirements by 2040 would be .91 mgd.

Because Cooper's contract with Sulphur Springs expires before 1990 and because the yield of Cooper's 3 city lakes is considered marginal, net water supply needs for Cooper after 1990 can be considered to be essentially equivalent to the total requirements shown.

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TABLE 7

BASELINE TOTAL M&I WATER REQUIREMENTS FOR THE CITY OF COOPER, HISTORICAL AND PROJECTED YEARS

YEAR	TOTAL M&I 1/
1977	.35
1985	.38
1990	.72
2000	.75
2010	.79
2020	.83
2030	.87
2040	.91

1/ Because Cooper's contract with Sulphur Springs expires before 1990 and because the yield of Cooper's three City lakes is considered marginal, net water supply needs for Cooper beginning in 1990 can be considered to be essentially equivalent to the total requirement shown.

Sulphur Springs

In 1978 the City of Sulphur Springs water system supplied 2.70 mgd of water. This amount includes .29 mgd supplied to the City of Cooper and .88 mgd supplied to seven rural water districts. The rural water districts are North Hopkins, Pleasant Hill, Shady Grove, Morten Springs, Brinker, Brashear, and Gafford Chapel.

About .25 mgd of water supplied by the city was used for industrial purposes. Processers of milk and producers of milk products used about .19 mgd of this amount. Fabricated metal producers used about .03 mgd. Lignite miners used about .3 mgd of the industrial water for sprinkling to minimize dust levels.

Municipal water use for the City of Sulphur Springs, excluding water supplied to other entities and to industrial users was 1.28 mgd. This represents a use rate of 81 gallons per person per day based on an estimated population of the city in 1978 of 15,881 persons. Included in the city's municipal component is .03 mgd supplied to the city's hospital.

The seven rural water districts supplied by Sulphur Springs use water at the rate of 175 gallons per person each day. This rate is based on an estimated 2 persons for each of rural water districts 2,517 meters. Reflected in this relatively high per capita use rate is the large amount of water used by the more than 500 Grade A Dairies in Hopkins County.

Table 8 shows projections of municipal industrial and total M&I requirements for the Sulphur Springs water system to the year 2040. Total M&I requirements are projected to increase to 5.5 mgd by the year 2040. This is more than twice the current usage despite the fact that after 1985 Cooper needs are no longer included with those of Sulphur Springs.

The water supply for the City of Sulphur Springs comes from Century Lake and Lake Sulphur Springs. Lake Sulphur Springs was completed in 1974. The Fort Worth District of the Corps of Engineers has recently conducted a study to determine the

TABLE 8

BASELINE MUNICIPAL, INDUSTRIAL, AND TOTAL WATER REQUIREMENTS FOR THE SULPHUR SPRINGS SYSTEM, HISTORICAL & PROJECTED

(MILLIONS OF GALLONS DAILY)

YEAR	MUNICIPAL	INDUSTRIAL	TOTAL
1978	2.42	.28	2.70
1985	2.83	.29	3.12
1990 1/	2.72	.30	3.02
2000	3.24	.35	3.59
2010	3.73	.38	4.11
2020	4.22	.42	4.64
2030	4.58	.51	5.09
2040	4.98	.52	5.50

1/ Decline in total M&I requirements between 1985-1990 reflects expiration of Cooper-Sulphur Springs water supply contract.

yield of the two lakes. The study concluded that the present yields of the two lakes were 1.9 mgd for Century and 7.1 mgd for Lake Sulphur Springs. These yields were based on period of record inflows. Because of sedimentation the yield of Lake Century is projected to decline to nothing by the year 2012. The yield of Lake Sulphur Springs is projected to decline to 5.2 mgd by 2040 and to 4.0 mgd by the year 2085.

Table 9 shows the projected total M&I water for the Sulphur Springs system and its projected supply to the year 2040. As this table indicates Sulphur Springs would need a new source of water sometime between 2030 and 2040.

TABLE 9

BASELINE TOTAL M&I WATER REQUIREMENTS VS
SUPPLY FOR THE SULPHUR SPRINGS SYSTEM,
HISTORICAL AND PROJECTED YEARS

(MILLIONS OF GALLONS DAILY)

YEAR	TOTAL M&I	SUPPLY 1/	NET NEEDS
1978	2.7	9.0	-
1985	3.1	8.5	-
1990 2/	3.0	8.1	-
2000	3.6	7.2	-
2010	4.1	6.3	-
2020	4.6	5.9	-
2030	5.1	5.6	-
2040	5.5	5.2	.3

1/ Combined yield from Century Lake and Lake Sulphur Springs.

2/ Decline in toal M&I requirements between 1985-1990 reflects expiration of Cooper-Sulphur Springs water supply contract.

III

MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS WITH CONSERVATION

Introduction

The President's Water Resources Policy Message of 6 June 1978 established water conservation as a cornerstone of federal water resources policy. A number of factors account for the growing emphasis on water conservation, some of which are: rising demand, scarcity of new reservoir sites, declining groundwater levels, rising costs of water resources development, and concern for environmental quality.

A variety of measures and techniques can be employed to encourage or implement water conservation. Public education through the use of television, radio and newspapers can be used to communicate the need to the public of conserving our water resources and describe techniques for achieving this objective. The use of water conservation devices such as shower flow controls, toilet inserts, and modified lawn sprinkling devices are relatively inexpensive and effective in reducing demand. Plumbing codes can be revised to require low flow showerheads and faucets and water saving toilets for new construction or replacement plumbing. Pricing and metering techniques can be employed to encourage conservation.

Within the Cooper Lake study area essentially all customers are metered, a practice which tends to discourage waste. However, rates charged these customers tend to be structured such that marginal cost of water tends to decline as total use increases.

The purpose of this section is to measure or assess the effects of a conservation program on municipal water requirements in the study area. Projections of total M&I requirements with this conservation program and the corresponding effect on net water supply needs are presented as an alternative to the baseline projections in the preceding section.

Baseline industrial water use projections have not been modified for the presentation of the conservation alternative. This is because past trends in industrial water use reflect increasing recirculation of water used in the industrial processes, primarily a response to pollution control laws. Therefore, the projection of these trends automatically reflect conservation.

In making the "with conservation" projections of municipal water needs, it was assumed that a water conservation program would be adopted which would affect both interior and exterior residential water use. For interior residential use, it was assumed that water saving toilets, faucets, and shower heads would be required in all new construction and that replacement of these items with the water saving types in existing residences would occur gradually with complete replacement occuring in 50 years.

It is notable that two major Texas cities have recently adopted plumbing ordinances which require water saving plumbing fixtures. In 1977 El Paso amended its plumbing code, requiring the installation of shower heads and toilets of the water saving type in all new and replacement construction. San Antonio adopted a code in September 1979 which requires that flush toilets in new buildings cannot use more than three gallons of water per flush. Shower heads and lavatory sink faucets cannot permit more than three gallons per minute. Table 10 shows the savings attributible to water saving devices which were used to make the "with conservation" projections for this study.

TABLE 10

THE EFFECTS OF WATER CONSERVATION DEVICES ON
PER CAPITA RESIDENTIAL WATER USE

FIXTURE	CURRENT WATER USAGE	WATER USAGE CONSIDERING CONSERVATION	PERCENT SAVINGS
Toilet	5 gallons and up per flush	3.5 gallons or less per flush	30%
Shower head	4 gallons per minute and up	3 gallons per minute or less	25%
Faucet	4 gallons per minute and up	1 gallon per minute or less	75%

SOURCE: U. S. Department of Interior, Office of Water Research and Technology, Water Conservation Devices, Residential Water Conservation, p.8.

Table 11 shows how water is used by a typical family of four. Such a family uses about 255 gallons per day. Toilet flushing is the biggest use accounting for about 39 percent of the total while bathing is second with 31 percent.

Table 12 shows the conversion of the data in Table 11 to a per capita basis and applies the expected percentage savings of the water saving devices shown in Table 10 to obtain estimates of the effects of the devices on a per capita, per day basis. As the Table shows, the installation of the water saving devices would be expected to save almost 12 gallons per person per day with 81 percent of the total savings attributable to toilet flushing and bathing savings.

To estimate the water savings attributable to the interior residential conservation program, the 11.81 per capita per day savings, from Table 12, was first applied to the difference in the projected years population and 1980 population. This gave an estimate of the projected savings attributable to requiring the conservation devices in all new construction.

To obtain the estimate associated with replacing the old fixtures the 1980 population was divided by 50. This number gave an estimate of the increase in the number of people each year who would be affected by replacement of old devices. To obtain the replacement savings in water in a given projected year, this number was multiplied by the number of years that would elapse from 1980 to the projected year. This product was then multiplied by 11.81 gallons per person per day to obtain the savings in water in the projected year attributable to replacement of old fixtures. The "replacement savings" was added to the "new construction" savings to get the total interior residential savings.

The exterior conservation savings were computed by first estimating the seasonal component of municipal water. The seasonal component is that portion

TABLE 11

HOW WATER IS USED BY A TYPICAL
AMERICAN FAMILY OF FOUR

USE	GALLONS USED PER DAY	PERCENT OF TOTAL
Dishwashing	15	6
Cooking, drinking	12	5
Utility sink (washing hands, etc.)	5	2
Laundry	35	14
Bathing	80	31
Bathroom sink	8	3
Toilet	100	39
Total	255	100

SOURCE: U.S. Department of Commerce, National Technical Information Service, PB-250 999, Proceedings of Conference on Water Conservation and Sewage Flow Reduction with Water-Savings Devices, July 1975, p. 93.

TABLE 12

EFFECTS OF CONSERVATION DEVICES ON
PER CAPITA RESIDENTIAL WATER USE

USE	WITHOUT CONSERVATION GALLONS USED PER PERSON PER DAY	WITH CONSERVATION GALLON USED PER PERSON PER DAY	SAVINGS GALLONS PER PERSON PER DAY
Dishwashing	3.75	3.75	--
Cooking, Drinking	3.00	3.00	--
Utility Sink	1.25	.94	.31
Laundry	8.75	8.75	--
Bathing 1/	20.00	16.25	3.75
Bathroom Sink	2.00	.50	1.50
Toilet	25.00	18.75	6.25
Total	63.75	51.94	11.81

1/ 75% shower, 25% bathtub assumed

of municipal water use which occurs in the Cooper Lake study area generally during months of June through October and consists primarily of landscape irrigation. The seasonal component was estimated first for a recent historical year and the ratio of the seasonal use to total use was computed.[2] This ratio was applied to project municipal water use to obtain an estimate of the seasonal component for projected years.

For the purposes of this report, it was assumed that the seasonal component could be reduced by seasonal pricing and customer education by 10 percent. The 10 percent reduction is a subjective estimate. At this time there is very little experience in this area on which to base an estimate of savings and 10 percent does not seem to be unreasonable.[3] The 10 percent reduction was applied to the projected estimate of the seasonal component to obtain the projected savings through conservation for exterior water use.

It should be noted that the institution of permanent water conservation measures allows less flexibility during periods of drouth. In the words of Professor William Whipple, Jr., "permanent measures of water conservation will not reduce the need for drought contingency water conservation but actually increase it since the permanently reduced water usage will leave less room for changes when a drought period occurs."[4]

The remainder of this section details the effects of interior and exterior conservation on each of the study area's water supplying entities for which baseline projections have been provided. Net needs are reassessed given the water conservation alternative.

[2]See Appendix A: Projection Methodology for the formula computing the seasonal component

[3]The sensitivity of total water requirements to change in the assumed percentage reduction of the seasonal component is assessed in Appendix A.

[4]Water Resources Research Institute, "Proceedings of the Conference on Water Conservation, Needs and Implementing Strategies," published by the American Society of Civil Engineers, 1979, pp. 22-27.

North Texas Municipal Water District

The effects of water conservation on projections of M&I water requirements for the NTMWD are shown in Table 13. The effect of the conservation program which would require water saving devices for new and replacement construction (interior conservation) would be to gradually reduce total requirements by 2 percent in 1985 and by 7 percent in 2030 and 2040. The Districts' seasonal component is about 25 percent of its total municipal use, and a 10 percent reduction in this component would reduce total requirements by 2 percent throughout the projection period. Therefore, the total effects of the conservation program would be to reduce total requirements by 4 percent in 1985 and 9 percent in 2020 and beyond.

Table 14 shows projections of total M&I water requirements for the District with conservation and compares these requirements with the available supply. Net water supply needs would occur for the District shortly after 1985. Net needs would reach 19.8 mgd in the year 2000 and 84.1 mgd in the year 2040. It is notable that if the NTMWD were to obtain its share from Cooper Lake for which it has contracted (39 mgd) it would still require an additional source sometime between the 2000-2010 decade to meet its needs.

TABLE 13

EFFECTS OF WATER CONSERVATION ON PROJECTIONS OF M&I WATER REQUIREMENTS FOR THE NTMWD

(MILLIONS OF GALLONS DAILY)

YEAR	WITHOUT CONSERVATION (BASELINE)	WITH INTERIOR CONSERVATION	% REDUCTION WITH INTERIOR CONSERVATION	WITH INTERIOR & EXTERIOR CONSERVATION	% REDUCTION WITH INTERIOR AND EXTERIOR CONSERVATION
1977	62.9	--	--	--	--
1985	91.6	90.2	2%	88.0	4%
1990	104.1	101.2	3%	98.8	5%
2000	119.6	114.4	4%	111.6	7%
2010	133.0	125.6	6%	122.6	8%
2020	150.6	140.9	6%	137.5	9%
2030	170.2	158.1	7%	154.2	9%
2040	193.7	180.3	7%	175.9	9%

TABLE 14

PROJECTIONS OF M&I WATER REQUIREMENTS WITH CONSERVATION, SUPPLY, AND NET WATER SUPPLY NEEDS WITH CONSERVATION FOR THE NTMWD

(MILLIONS OF GALLONS DAILY)

YEAR	TOTAL M&I	SUPPLY 1/	NET NEEDS
1977	62.9	91.8	--
1985	88.0	91.8	--
1990	98.8	91.8	7.0
2000	111.6	91.8	19.8
2010	122.6	91.8	30.8
2020	137.5	91.8	45.7
2030	154.2	91.8	62.4
2040	175.9	91.8	84.1

1/ Yield from Lake Lavon, the current source of supply.

Irving

The effect of interior water conservation on City of Irving requirements as shown in Table 15 would be to reduce total requirements from 1 percent in 1985, gradually increasing to a 7 percent reduction in 2030 and 2040. The effect of the 10 percent reduction in the seasonal component, which accounts for 20 percent of Irvings total use, would be to reduce total requirements by an additional 2 percent throughout the projection period. The total effect of the conservation program would be to reduce total M&I requirements by 3 percent in 1985 to 9 percent in 2030 and 2040.

As previously mentioned, Irving would have to find an additional source after 2007 when its contract with Dallas expires. As Table 16 indicates, with conservation, the City would have needs in 2010 of 24.9 mgd increasing to 33.0 mgd in 2040.

TABLE 15

EFFECTS OF WATER CONSERVATION ON PROJECTIONS OF M&I WATER REQUIREMENTS FOR THE CITY OF IRVING

(MILLIONS OF GALLONS DAILY)

YEAR	WITHOUT CONSERVATION (BASELINE)	WITH INTERIOR CONSERVATION	% REDUCTION WITH INTERIOR CONSERVATION	WITH INTERIOR AND EXTERIOR CONSERVATION	% REDUCTION WITH INTERIOR AND EXTERIOR CONSERVATION
1977	16.7	—	--	--	—
1985	20.1	19.8	1%	19.4	3%
1990	21.5	21.1	2%	20.7	4%
2000	24.7	23.8	4%	23.3	6%
2010	26.8	25.5	5%	24.9	7%
2020	29.5	27.7	6%	27.1	8%
2030	32.3	30.1	7%	29.5	9%
2040	36.0	33.7	7%	33.0	9%

TABLE 16

PROJECTIONS OF M&I WATER REQUIREMENTS WITH CONSERVATION, SUPPLY, AND NET WATER SUPPLY NEED WITH CONSERVATION FOR THE CITY OF IRVING

(Millions of Gallons Daily)

YEAR	TOTAL M&I	SUPPLY	NET NEEDS
1977	16.7	(a)	-
1985	19.4	(a)	-
1990	20.7	(a)	-
2000	23.4	(a)	-
2010	24.9	(b)	24.9
2020	27.1	(b)	27.1
2030	29.5	(b)	29.5
2040	33.0	(b)	33.0

(a) Supply is from City of Dallas which according to the contract would meet Irving's needs until expiration in 2007.

(b) Supply is zero based on expectation that Dallas, in anticipation of a water supply deficit between 2010 and 2020, would not renew its contract with Irving.

COMMERCE

The effect of the interior conservation program on the City of Commerce would be to reduce its total requirements by 1 percent in 1985 and increase the reduction to 5 percent by 2020 (Table 17). The seasonal component in Commerce accounts for only 9 percent of total municipal water use in the city. A 10 percent reduction in the seasonal component would reduce total use by 1 percent throughout the projection period. The combined effect of the interior and exterior conservation program would be to reduce total M&I requirements by 1 percent in 1985 and by 6 percent by 2020.

Table 18 shows net needs with conservation for the City of Commerce. If the city's contract with the SRA were not renewed in 2027 the city would have net needs of 3.0 mgd in 2030 and 3.3 mgd in 2040.

TABLE 17

EFFECTS OF WATER CONSERVATION ON PROJECTIONS OF M&I WATER REQUIREMENTS FOR THE CITY OF COMMERCE

(MILLIONS OF GALLONS DAILY)

YEAR	WITHOUT CONSERVATION (BASELINE)	WITH INTERIOR CONSERVATION	% REDUCTION WITH INTERIOR CONSERVATION	WITH INTERIOR & EXTERIOR CONSERVATION	% REDUCTION WITH INTERIOR AND EXTERIOR CONSERVATION
1978	1.71	--	--	--	--
1985	2.06	2.04	1%	2.02	2%
1990	2.23	2.21	2%	2.17	3%
2000	2.50	2.42	3%	2.40	4%
2010	2.69	2.58	4%	2.56	5%
2020	2.86	2.73	5%	2.71	6%
2030	3.15	2.98	5%	2.96	6%
2040	3.51	3.34	5%	3.31	6%

TABLE 18

PROJECTIONS OF M&I WATER REQUIREMENTS WITH CONSERVATION, SUPPLY, AND NET WATER SUPPLY NEEDS WITH CONSERVATION FOR THE CITY OF COMMERCE

(MILLIONS OF GALLONS DAILY)

YEAR	TOTAL M&I	SUPPLY 1/	NET NEEDS
1978	1.7	7.5	--
1985	2.0	7.5	--
1990	2.2	3.0	--
2000	2.4	3.0	--
2010	2.6	3.0	--
2020	2.7	3.0	--
2030	3.0	--	3.0
2040	3.3	--	3.3

1/ Numbers shown are amounts of Lake Tawakoni water available to the city according to the terms of its contract with the Sabine River Authority. The contract expires in 2027.

Cooper

Monthly water use data for the City of Cooper is not available to compute the seasonal component of municipal water use. However, landscape irrigation in the area is thought to be minimal.

Interior conservation is expected to reduce total water requirements by 1 percent beginning in 1985 up to 8 percent in 2030 and 2040. With conservation the city's requirements would grow from .35 mgd in 1978 to .83 mgd by 2040.

As previously mentioned, because Cooper's contract with Sulphur Springs expires before 1990 and because the yield of Cooper's 3 city lakes is considered marginal, net water supply needs with conservation are considered to be essentially equivalent to the total requirements shown in Table 19.

TABLE 19

EFFECTS OF WATER CONSERVATION ON PROJECTIONS OF M&I WATER REQUIREMENTS FOR THE CITY OF COOPER SYSTEM

(MILLIONS OF GALLONS DAILY)

YEAR	WITHOUT CONSERVATION (BASELINE)	WITH INTERIOR CONSERVATION	% REDUCTION WITH INTERIOR CONSERVATION
1978	.35	-	-
1985	.38	.37	1%
1990	.72	.71	1%
2000	.75	.72	3%
2010	.79	.75	5%
2020	.83	.77	6%
2030	.87	.79	8%
2040	.91	.83	8%

Sulphur Springs

As shown in Table 20, Total M&I water requirements for Sulphur Springs would be reduced by 1 percent in 1985, 6 percent in 2000, and 9 percent in 2020 with interior conservation. The seasonal component in Sulphur Springs accounts for 9 percent of total annual municipal use. A 10 percent reduction in the seasonal component would reduce total M&I requirements by 1 percent throughout the projection period. Total requirements would be reduced by 4 percent in 1985 with the reduction increasing to 9 percent by 2020 with both interior and exterior programs in effect.

As Table 21 indicates there are no net water supply needs for the Sulphur Springs system throughout the projection period. However, with continued growth and continuing sedimentation in the city lake, the city would need water very shortly after 2040.

TABLE 20

EFFECTS OF WATER CONSERVATION ON PROJECTIONS OF M&I
WATER REQUIREMENTS FOR THE SULPHUR SPRINGS SYSTEM

(MILLIONS OF GALLONS DAILY)

YEAR	WITHOUT CONSERVATION (BASELINE)	WITH INTERIOR CONSERVATION	% REDUCTION WITH INTERIOR CONSERVATION	WITH INTERIOR & EXTERIOR CONSERVATION	% REDUCTION WITH INTERIOR AND EXTERIOR CONSERVATION
1978	2.70	-	-	-	
1985	3.12	3.08	1%	3.04	2%
1990 1/	3.02	2.92	3%	2.96	4%
2000	3.59	3.39	6%	3.36	6%
2010	4.11	3.83	7%	3.80	8%
2020	4.64	4.27	9%	4.23	9%
2030	5.09	4.65	9%	4.61	9%
2040	5.50	5.04	9%	5.00	9%

1/ Decline in total M&I requirements between 1985-1990 reflects expiration of Cooper-Sulphur Springs water supply contract.

TABLE 21

PROJECTIONS OF M&I WATER REQUIREMENTS WITH CONSERVATION, SUPPLY AND NET WATER SUPPLY NEEDS WITH CONSERVATION FOR THE SULPHUR SPRINGS SYSTEM

(MILLIONS OF GALLONS DAILY)

YEAR	TOTAL M&I	SUPPLY 1/	NET NEEDS
1978	2.7	9.0	-
1985	3.0	8.5	-
1990 2/	2.9	8.1	-
2000	3.4	7.2	-
2010	3.8	6.3	-
2020	4.2	5.9	-
2030	4.6	5.6	-
2040	5.0	5.2	-

1/ Combined yields from Century Lake and Lake Sulphur Springs.

2/ Decline in Total M&I requirements between 1985-1990 reflects expiration of Cooper-Sulphur Springs water supply contract.

APPENDICES

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APPENDIX A: PROJECTION METHODOLOGY

Baseline Projections

Baseline projections of municipal water use were made by combining projections of population and per capita municipal water use rates. Population projections (Table A-1) were based primarily on a disaggregation of OBERS Series "E" projections for Bureau of Economic Analysis (BEA) Economic Area 127 and for the Dallas Standard Metropolitan Statistical Area (SMSA). These projections in the case of Collin, Rockwall, and Hopkins Counties were modified upward by the recent trends in rapid growth in these areas. Projections given by local entities were reviewed and given careful consideration in making these projections.

Table A-1 shows population projections for each of the water supply entities which are potential users of Cooper Lake. The historical year population figures were based essentially on Census Bureau population estimates.[1] Population numbers for the Cities of Cooper and Sulphur Springs also include estimates of the customers in the rural water districts served or to be served by the municipal systems. Sulphur Springs 1978 estimate includes 5,034 persons outside the City based upon 2 persons per meter. The number of persons estimated to be served by the City of Cooper via the Charleston Water Supply Company is 767. It is also projected that the City of Cooper would begin supplying an additional 5,985 persons in 1990 given the depletion and deteriorating quality of groundwater in the Sulphur River Basin.

The 1978 population of Sulphur Springs was estimated by the Corps of Engineers to be 15,900 inhabitants. This is significantly higher than the 11,191 persons estimated by the Census Bureau for 1977. The higher Corps estimate was based upon recent data on utility connections and number of residences as well as on independent population estimates by the various utility companies and by the city government of Sulphur Springs.

[1] U.S. Bureau of the Census, Current Population Reports, Population Estimates and Projections, Series P-25, No. 782, issued January 1979, and No. 856, issued November 1979.

TABLE A-1

POPULATION PROJECTIONS FOR THE COOPER LAKE
STUDY AREA, BY SYSTEM

YEAR	NTMWD	IRVING	COMMERCE	COOPER	SULPHUR SPRINGS
1977 1/	414,200 2/	105,070	9,200	2,740	20,900
1985	591,600	124,800	10,960	2,956	23,400
1990	666,000	132,600	11,600	6,000	25,500
2000	754,900	149,800	12,900	6,200	29,600
2010	834,800	161,100	13,600	6,300	32,600
2020	923,900	173,300	13,900	6,400	35,600
2030	1,023,300	186,300	14,600	6,600	37,300
2040	1,134,100	200,400	15,000	6,700	39,200

1/ Historical year for Commerce and Sulphur Springs is 1978

2/ Includes only 62.5 percent of Richardson's population, the percent of the City's total water needs supplied by the NTMWD in 1977. Beginning in late 1979, the NTMWD began supplying all of Richardson's needs.

The 1977 population estimate for the NTMWD was computed by adding the 1977 Census Bureau estimates for each of the member and customer cities. To this total was added estimates given by the NTMWD of 33,770 persons for "others" and 60,000 persons supplied by NTMWD living in the City of Dallas. Only 62.5 percent of the City of Richardsons population was included in estimating the 1977 population served by the NTMWD since only 62.5 percent of its water was supplied by the NTMWD in that year.

Base year municipal use rates were derived from actual water use data provided by local officials. Municipal use in the historical year was combined with the population estimates to obtain a per capita municipal use rate. These per capita municipal use rates were projected (Table A-2) based on county urban projections made by the Texas Department of Water Resources (TDWR). The TDWR projections reflect past trends in growth in municipal water use per capita.

Industrial water use projections were made by combining projections of employment growth, productivity per employee, and recirculation rates to base year water use estimates by two digit Standard Industrial Classification (SIC). Base year industrial water use estimates were obtained through field investigation and survey data provided by the TDWR. Employment growth rates were based on OBERS Series "E" projections. Productivity indexes, or indexes of output per employee, were derived by applying OBERS projections of gross product originating to earnings factors to its national earnings projections and dividing by its projections of national employment for each industry. Recirculation rates by two digit SIC were projected by extrapolating historical trends using least squares regression.

TABLE A-2

BASELINE PER CAPITA MUNICIPAL WATER USE RATES
FOR THE COOPER LAKE STUDY AREA, BY SYSTEM
HISTORICAL AND PROJECTED
(Gallons Per Capita Day)

YEAR	NTMWD	IRVING	COMMERCE	COOPER	SULPHUR SPRINGS
1977 1/	138	150	153	114	103
1985	140	152	158	117	105
1990	141	154	160	120	107
2000	144	156	165	122	109
2010	146	159	169	125	114
2020	149	162	173	129	119
2030	152	165	178	132	123
2040	155	169	184	136	127

1/ Historical year for Commerce and Sulphur Springs is 1978.

The Seasonal Component

Below is given the formula for the computation of the seasonal component and seasonal component factor

S = seasonal component

$\overline{S}$ = seasonal component factor

M1 = total municipal use, June-Oct (153 days)

M2 = total municipal use Jan-May and Nov-Dec (212 days)

M = total municipal use for one year = M1 + M2

$$S = \left(\frac{M1}{153} - \frac{M2}{212} \right) 153$$

$$\overline{S} = \frac{S}{M}$$

Table A-3 gives an estimate of the sensitivity of the total M&I requirements for water supplying entities in the study area to changes in the seasonal component, i.e., it tells how much total water use will decline for each 10 percent reduction in seasonal water use. Note that Commerce and Sulphur Springs total requirements are much less sensitive to a given percent reduction in the seasonal component than are the NTMWD and Irving. This is simply because the seasonal components for Commerce and Sulphur Springs are considerably smaller. These numbers or relationships would apply to any projected year in this study since the projected seasonal component is about the same percentage of the total each year. Because the seasonal component is projected to be a constant percentage of the municipal component its relationship to total M&I will remain relatively constant so long as the relationship between municipal and industrial remains relatively stable.

TABLE A-3

THE PERCENTAGE REDUCTION IN TOTAL M&I WATER USE
FOR EACH 10 PERCENT REDUCTION IN SEASONAL WATER USE, BY CITY

NTMWD	IRVING	COMMERCE	SULPHUR SPRINGS
2.3%	2.0%	.7%	.8%

APPENDIX B

PROJECTIONS OF NEEDS FOR THE CITY OF DALLAS SYSTEM

Table B-1 shows the supply of water available and potentially available to the City of Dallas system. Presently the city's pipeline to Tawakoni limits it to 100 mgd but another pipeline is being constructed which would allow it to take the full 164.6 mgd for which it has contracted. The city currently is not using water from Lake Palestine and would have to construct a pipeline to it in order to do so. Lake Aubrey is an authorized Corps of Engineer project not yet under construction.

Table B-2 shows the projections of M&I water requirements for the City of Dallas system which consists of needs for the city itself and its customer cities.[1] As indicated in the table with the construction of Aubrey the system could meet its needs until sometime between 2010 and 2020.

[1]These projections were derived from updated projections made for the "Denison Dam (Lake Texoma) Restudy" water supply study done in June 1979 by the Southwestern Division, Corps of Engineers.

TABLE B-1

PROJECTIONS OF THE SUPPLY OF WATER AVAILABLE
TO THE CITY OF DALLAS SYSTEM

(Millions of Gallons Daily)

SOURCE	1977	2000	2010	2020	2040
Grapevine 1/	10.9	10.9	10.9	10.9	10.9
Ray Hubbard 2/	65.1	65.1	65.1	65.1	64.0
Tawokoni 2/	164.6	164.6	164.6	164.6	164.6
Palestine 2/	102.0	102.0	102.0	102.0	102.0
Lewisville, 1/ 3/ Aubrey	101.5	129.6	127.3	125.9	124.7
Total	444.1	472.2	469.9	468.5	466.2

SOURCE OF YIELD FIGURES:

1/ U.S. Army Corps of Engineers

2/ Texas Department of Water Resources

3/ Yield of Aubrey and Lewisville Lakes are combined because the construction of Aubrey would change the yield of Lewisville. Construction of Aubrey would be completed before 2000 and is reflected in year 2000 yield estimate. Decline in yield figures beyond 2000 for Lewisville-Aubrey and after 2000 for Ray Hubbard indicates reductions because of sedimentation.

NOTE: The figures shown for each lake are the amounts for which the City of Dallas has contracted and not necessarily the full yield of the lake.

TABLE B-2

PROJECTIONS OF TOTAL M&I WATER REQUIREMENTS, SUPPLY, AND NET WATER SUPPLY NEEDS FOR THE CITY OF DALLAS, SYSTEM

(Millions of Gallons Daily)

YEAR	TOTAL REQUIREMENTS	SUPPLY	NET NEEDS
1977	258	444	-
2000	386	472	-
2010	427	470	-
2020	498	468	30
2040	626	466	160

APPENDIX C

Irrigation of Agricultural Land in the Study Area

Historically, irrigation of agricultural land in the study area has been relatively unimportant. As shown in Table C-1, only 1,541 acres of cropland were irrigated in 1974 in the study area. This was only about .3 percent of the total or 480,054 acres of harvested cropland. Kaufman and Rockwall Counties have essentially no irrigation of cropland. The amount of cropland irrigated in 1969 in the study area was 6,231 acres, about 1 percent of the 621,548 acres harvested in that year. Hay and corn were the principal crops irrigated in 1974 and cotton was the primary crop in 1969.

As Table C-2 indicates, a very small amount of pastureland had some irrigation in 1969 and 1974. In 1974, 413 acres were irrigated, less than one tenth of one percent. Only Hopkins and Dallas County had significant irrigation of pastureland in 1974.

TABLE C-1

TOTAL HARVESTED CROPLAND AND IRRIGATED CROPLAND
BY COUNTY FOR THE COOPER LAKE STUDY AREA, 1969 & 1974
(Acres)

COUNTY	Total Harvested Cropland 1969	Total Harvested Cropland 1974	Irrigated Cropland 1969	Irrigated Cropland 1974
Collin	210,920	167,705	202	124
Dallas	94,078	54,817	2,351	519
Delta	51,457	36,831	200	24
Hopkins	33,235	39,465	674	637
Hunt	113,812	91,549	153	235
Kaufman	91,334	75,526	2,651	-0-
Rockwall	26,712	14,161	-0-	2
Totals	621,548	480,054	6,231	1,541

SOURCES: U.S. Bureau of the Census, Census of Agriculture: 1974.

TABLE C-2

TOTAL PASTURELAND AND IRRIGATED PASTURELAND
BY COUNTY FOR THE COOPER LAKE STUDY AREA, 1969 & 1974
(Acres)

COUNTY	Pastureland 1969	Pastureland 1974	Irrigated Pastureland 1969	Irrigated Pastureland 1974
Collin	109,535	71,700	60	-0-
Dallas	60,697	31,849	426	112
Delta	47,601	51,888	-0-	-0-
Hopkins	185,842	132,063	140	300
Hunt	123,152	116,262	38	-0-
Kaufman	149,491	122,064	960	-0-
Rockwall	16,051	11,296	-0-	1
Totals	692.369	537,122	1,624	413

SOURCE: U.S. Bureau of the Census, Census of Agriculture: 1974.

Appendix D

Exhibit 3

GROUNDWATER REPORT

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

April 3, 1980

Mr. Jimmy D. Baggett
Acting Chief, Engineering Division
U.S. Army Corps of Engineers
Fort Worth District
P.O. Box 17300
Fort Worth, Texas 76102

Attention: Mr. Mike Mocek

Dear Mr. Baggett:

Enclosed are two copies of a report entitled "Ground Water Resources of the Cooper Lake and Channels Project Area." This report was prepared by the Department's Planning and Development Division in response to your letter of March 6, 1980.

We have appreciated this opportunity to work with the Corps on a project that is of great importance to the water resources development program in Texas. If we can be of further assistance, please let us know.

Should you have any questions concerning the enclosed report, please contact Allen White or Bob Bluntzer at 512/475-3821.

Sincerely,

Harvey Davis
Executive Director

Appendix D
Exhibit 3
1

P.O. Box 13087 Capitol Station ● Austin, Texas 78711 ● Area Code 512/475-3187

GROUND-WATER RESOURCES
OF THE
COOPER LAKE AND CHANNELS PROJECT AREA

INTRODUCTION

By letter dated March 6, 1980 the U.S. Army Corps of Engineers, Fort Worth District formally requested the Department's assistance with work on the Cooper Lake and Channels Project. Specifically, the Corps requested the following information:

1. Identification of ground-water resources in and adjacent to the Cooper Lake and Channels Project area.
2. Potential dependable yields of aquifers identified in item 1., projected for the 100-year period from 1990 to 2090.
3. Ground-water quality in aquifers identified in item 1., projected for the 100-year period from 1990 to 2090, and
4. Current and committed future usage from aquifers identified in item 1.

The purpose of this report is to address the specific topics listed above. However, from a practical standpoint, and in order to put the issue of ground water supply as an alternative to water supply storage in Cooper Lake in the proper persepective, it would be necessary to examine the specific present and future water supply needs of the three governmental entities which would own water supply storage in Cooper Lake as well as the potential for each entity to acquire, develop, and distribute ground water to their customers.

Non-federal participants in the Cooper Lake and Channels Project which have executed contracts with the federal government for repayment of costs allocated to water supply storage in Cooper Lake are the North Texas Municipal

Water District, City of Irving, and the Sulphur River Municipal Water District. These entities would own 36.859, 36.859, and 26.282%, respectively, of the 273,000 acre-feet of water supply (conservation) storage in Cooper Lake and would be allowed to divert annually, under provisions of Permits No. 2337, 2336, and 2338 issued by the Texas Water Commission, 54,000, 54,000, and 38,520 acre-feet, respectively, for use in their service area.

In order to develop an equivalent amount of water supply from ground-water sources, each of the above entities, either acting independently or collectively, would have to conduct extensive studies of the availability of the nearest, most economically feabible source of ground water to meet their needs. Also, since each entity's existing water supply storage and distribution systems are unique, means of conveyance, storage, and distribution of ground water to their customers would differ.

STUDY AREA

The Cooper Lake and Channels Project area, as defined in the Corps' March 6, 1980 letter, is composed of Collin, Dallas, Rockwall, Kaufman, Hunt, Delta, and Hopkins counties which are located in the upper Trinity, upper Sabine, and upper Sulphur River basins (Figure 1).

Two major aquifers and two minor aquifers occur in and adjacent to the Project area. A major aquifer is defined as one which yields large quantities of water in a comparatively large area of the State. A minor aquifer is defined as one which yields relatively large quantities of water in small areas of the State or relatively small quantities of water in large areas of the State.

The two major aquifers are the Trinity Group and the Carrizo-Wilcox. The two minor aquifers are the Woodbine and the Nacotoch. Altogether, these four aquifers underlie 85 percent of the seven-county Project area. The outcrops (recharge areas) of these aquifers and their downdip extents are delineated in Figures 2 and 3. The aquifer areas delineated in Figures 2 and 3 are the approximate areas where the aquifers contain ground waters having 3,000 milligrams per liter (mg/l) or less total dissolved solids (fresh to slightly saline). Fresh water has 1,000 mg/l or less total dissolved solids. Slightly saline water has a total dissolved solids content greater than 1,000 mg/l and equal to or less than 3,000 mg/l.

CHARACTERISTICS OF THE AQUIFERS

Trinity Group Aquifer

In the Project area the Trinity Group is composed of two principle water-bearing units; the Twin Mountains (Travis Peak) Formation which is the lower or deepest unit, and the Paluxy Formation which is the upper or shallowest unit. These water-bearing units are separated by limestone, marl, shale, and anhydrite strata of the Glen Rose Formation which does not produce significant amounts of ground water in the Project area. Currently, about ninety percent of the ground water produced from the Trinity Group Aquifer in the Project area is from the Twin Mountains Formation which is composed of fine to coarse sand with some beds of shale, clay, gravel and conglomerate. The remaining ten percent of ground-water produced is from the Paluxy Formation which is composed of fine sand, sandy shale, and shale. The top of the Trinity Group (Paluxy Formation) is encountered at depths ranging from about 800 to 3,300

feet in the Project area. The total thickness of the Trinity Group in the Project area ranges from about 1,000 to 2,800 feet with a net water-bearing sand thickness of about 100 to 580 feet. Currently, water used in the Project area from the Trinity group Aquifer is produced at a maximum depth of about 4,100 feet.

Measured and reported yields of wells completed in the Twin Mountains Formation range from 10 to 1,900 gallons per minute (gpm) with an average yield of about 286 gpm. Wells completed in the Paluxy Formation have yields ranging from 10 to 482 gpm with an average yield of about 97 gpm. The average specific capacities of wells completed in the Twin Mountains and Paluxy Formations are approximately 1.6 and 3.3 gallons per minute per foot (gpm/ft) of drawdown, respectively.

In the Project area, the transmissibility of the Twin Mountains Formation averages about 9,000 gallons per day per foot (gpd/ft). The average permeability is about 68 gallons per day per square foot (gpd/ft^2). The Paluxy Formation has an average transmissibility and an average permeability of 3,700 gpd/ft and 50 gpd/ft^2, respectively. Both formations have an average coefficient of storage of about 0.0001.

During the mid- and late 1970's, maximum depths of water levels in the Twin Mountains Formation were measured at 210 to 562 feet in Collin County and 434 to 992 feet in Dallas County. From 1955 to 1975 water levels of the Twin Mountain Formation declined from 200 to 275 feet in Collin County and from 197 to 508 feet in Dallas County.

During the mid- to late 1970's, maximum depths to Paluxy Formation water levels were 516 to 583 feet in Collin County, 401 to 500 feet in Dallas County, 444 feet in Hunt County, 331 feet in Rockwall County, 223 feet in Kaufman County, and 190 feet in Delta County. Measured water levels in Dallas County indicate that from 1955 to 1975 Paluxy Formation water levels declined 130 to 300 feet.

The great water level depths and large water level declines described above are definite indications of the serious overdrafts of ground water which have occurred in the Trinity Group Aquifer particularly in Dallas County since 1955. These deep water levels and large water-level declines cause serious economic and water quality problems; such as, the cost of lifting the water great vertical distances to the land surface (probably more than 1,000 feet in some areas), and saline water encroachment in some parts of the Project area in wells completed adjacent to the base and downdip extent of slightly saline water.

Carrizo-Wilcox Aquifer

The Wilcox Group in the Project area in Hopkins County has maximum thicknesses of about 760 to 960 feet, and is composed of fine to medium, discontinous sands interbedded with discontinuous layers of silt, clay, shale and lignite. The Carrizo Sand, the lowest unit in the Clairborne Group, has maximum thicknesses of 80 to 200 feet, and is composed of fine to coarse sand and minor amounts of silt and clay overlying the Wilcox Group. These deposits of the Wilcox Group and Carrizo Sand are hydrologically connected and form the Carrizo-Wilcox Aquifer.

In Hopkins County, both the Wilcox Group and Carrizo Sand outcrop in approximately the southeastern one-third of the county. These outcrops are the areas where the Carrizo-Wilcox Aquifer is recharged by infiltration of rainfall. Records of wells and springs in Franklin County indicate several springs in these outcrops which implies that the aquifer is full or near full, and is rejecting recharge. At the southeastern corner of Hopkins County the top of the aquifer (Carrizo Sand) occurs about 100 to 200 feet below the land surface. The approximate thicknesses of sands containing fresh water in the Carrizo-Wilcox Aquifer in Hopkins County is about 50 to 300 feet. Usable quality water is found at maximum depths of approximately 600 to 700 feet near the southeastern corner of Hopkins County.

Carrizo-Wilcox Aquifer wells in northwestern Wood County yield from 50 to 450 gallons per minute, and have specific capacities of 0.8 to 1.8 gpm/ft. This information is based on measured and reported yields and well performance tests. These same values can be expected in Hopkins County.

Transmissibilities of 800 to 8,600 gpd/ft were determined for the aquifer from tests conducted in northwestern Wood County. In Wood County the aquifer has a permeability of about 50 gpd/ft^2. One of the tests in Wood County indicated a coefficient of storage of 0.00046. These same values can be expected in Hopkins County.

Records of Carrizo-Wilcox Aquifer wells in Franklin and Wood counties indicate that water levels in several wells occur at levels above the land surface; thus allowing the wells to flow 1 to 25 gpm at the surface. In other areas of higher elevations, water levels of the aquifer generally occur from 10 to 100 feet below the land surface. A water level observation well in the City of Winnsboro near the southeast corner of Hopkins County in Franklin County had a

water level 115 feet below the land surface in 1977. Historical water-level records for this same well indicate that Carrizo-Wilcox Aquifer water levels declined about 5.5 feet from 1951 to 1977 due to pumpage in the Winnsboro area.

Woodbine Aquifer

In the Project area, the Woodbine Group is composed of medium to coarse sand and sandstone with some clay and lignite. Lignite and sandy clay layers occur predominantly in the upper part. The top of the Woodbine Group occurs at depths ranging from less than 100 feet to about 1,900 feet in the Project area. The maximum thickness of the Woodbine Group is about 600 feet with a net water-bearing sand thickness of 115 to 345 feet in the Project area. Currently, water used in the Project area from the Woodbine Aquifer is produced at a maximum depth of about 2,100 feet.

Measured and reported yields of wells completed in the Woodbine Aquifer range from about 50 to 740 gpm. The specific capacities of wells range from about 1 to 9 gpm/ft.

The transmissibilities and permeabilities of the aquifer range from 1,300 to 16,700 gpd/ft and 14 to 178 gpd/ft^2, respectively. The aquifer has an average coefficient of storage of about 0.00015.

During the mid- to late 1970's, measured maximum depths to water-levels were about 540 feet in Dallas County, 526 feet in Collin County, 450 feet in Hunt County, and 305 feet in Kaufman County. From 1955 to 1975, approximate water-level declines in these counties ranged from 10 to 204 feet in Dallas

County, 50 to 100 feet in Collin County, 50 to 100 feet in Hunt County, and 40 to 50 feet in Kaufman County. These measured water-level data indicate serious overdrafts of ground water from the Woodbine Aquifer in the Project area. Ground-water developers of the Woodbine Aquifer in the Project area, particularly in Collin and Dallas counties, are faced with serious problems of lifting the water great vertical distances to the land surface (probably more than 600 feet in some areas).

Nacatoch Aquifer

The Nacatoch Sand is the lowermost formation of the Navarro Group in the Project area, and is composed of fine sand and marl. Maximum thicknesses range from about 350 to 500 feet, with producing sand thicknesses from about 20 to 156 feet. Limited well data in the Project area indicate that sands producing usable quality of water from the Nacatoch Aquifer occur at depths ranging from 400 to 620 feet in Delta County, 70 to 652 feet in Hunt County, and 40 to 300 feet in Kaufman County.

Wells completed in the Nacatoch Aquifer in the Project area have measured and reported yields ranging from 125 to 254 gpm in Delta County, 20 to 335 gpm in Hunt County, and 40 to 100 gpm in Kaufman County. Specific capacities of wells in Delta and Hunt counties range from about 1 to 9 gpm/ft.

A limited number of aquifer tests in the Project area indicate transmissibilities and permeabilities ranging from about 2,150 to 2,670 gpd/ft and 26 to 70 gpd/ ft^2, respectively.

Currently, maximum depths to water levels in the Project area are probably about 550 feet. Limited water level data in Hunt County indicate that maximum water level declines were probably about 190 to 200 feet from 1914 to 1971.

AVAILABILITY AND POTENTIAL YIELD OF AQUIFERS

The computed annual effective recharge, recoverable storage, and average annual ground-water availability, or safe annual withdrawal rate, in each county through the year 2090 for each of the aquifers within the Cooper Lake and Channels Project area are given in Table 1. No estimates of recoverable storage were made for the Woodbine and Nacotoch Aquifers because of insufficient data.

Obviously, the quantity of water in storage in the Trinity Group Aquifers and Carrizo-Wilcox Aquifers can be withdrawn at a wide range of annual rates which can vary from year to year; i.e., it is not possible to predict what these annual rates will be with any degree of certainty. However, for the purpose of discussion, a baseline computation of the estimated withdrawal of water from storage can be made for each of these two aquifers. In this case, the Corps has assumed a planning horizon of 2090. Thus, an annual storage depletion rate can be calculated by dividing the recoverable storage by 115 years, which is the planning period from 1976 through the year 2090. This annual depletion rate is then added to the estimated annual effective recharge to give the estimated average annual ground-water availability as shown in Table 1.

The most productive aquifer is the Trinity Group Aquifer. The total potential annual ground-water yield from all aquifers in the seven-county Project area

[illegible]

Aquifer	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]		[illegible]	[illegible]
	[illegible]		[illegible]	
	Kaufman		[illegible]	[illegible]
	Rockwall	[illegible]	[illegible]	
[illegible] Totals		[illegible]	[illegible]	[illegible]
Carrizo-Wilcox	Hopkins	[illegible]	[illegible]	[illegible]
Woodbine	Collin	[illegible]		[illegible]
	Dallas	[illegible]		[illegible]
	Hunt	[illegible]		
	Kaufman	[illegible]		
	Rockwall	[illegible]		[illegible]
Woodbine Totals		[illegible]		[illegible]
Nacatoch	Delta	[illegible]		
	Hopkins	[illegible]		
	Hunt	[illegible]		
	Kaufman	[illegible]		
Nacatoch Totals		[illegible]		[illegible]
Totals All Aquifers		18,[illegible]	[illegible]	[illegible]
Totals	Collin	[illegible]	[illegible]	[illegible]
	Dallas	[illegible]	[illegible]	[illegible]
	Delta	[illegible]	[illegible]	
	Hopkins	2,[illegible]	[illegible]	[illegible]
	Hunt	[illegible]	1[illegible]	
	Kaufman	1,[illegible]	[illegible]	[illegible]
	Rockwall	[illegible]	[illegible]	[illegible]
Totals All Counties		1[illegible]	[illegible]	[illegible]

1/ None allocated
2/ Not determined because sufficient data are not available.
3/ Continued overdrafting of the aquifer in Dallas and Hunt Counties since January 1976 has substantially depleted the recoverable storage estimated at that time.

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Table 2 Reported Ground-Water Pumpage from Aquifers in the Cooper Lake and Channels Project Area, by County, in Acre-feet

County	Ground-Water Pumpage 1974	1976	1978
Collin	4,289	1,778	1,158
Dallas	23,040	24,326	13,262
Delta	352	65	69
Hopkins	2,015	457	464
Hunt	2,990	1,563	1,887
Kaufman	444	-0-	-0-
Rockwall	192	-0-	-0-
Total All Counties	33,322	28,189	16,820

As stated previously, it is impossible to accurately predict what ground-water withdrawals will be in the future. The trends in Table 2 indicate that ground-water pumpage is decreasing and it is anticipated that this trend will continue in the future. Rural areas will continue to depend on ground water as their source of water supply; however, these demands are very small in relation to those of the populated centers in the area. Some of the major users of ground water in the past will probably operate their pumps from time to time to keep the seals wet and possibly to satisfy peak water demand periods. Ground water is no longer a viable, dependable long-term source of water supply in the seven-county Project area.

GROUND-WATER QUALITY

Trinity Group Aquifer

Ground-water quality of this aquifer is represented by more than 200 chemical analyses of water samples taken in Collin and Dallas counties. Results from these analyses are given in Table 3. In the Project area, the two constituents in ground waters from the Trinity Group Aquifer which consistently do not meet Environmental Protection Agency (EPA) and Texas State Health Department (TSHD) Safe Drinking Water Standards (Primary and Secondary) are fluoride (F) and iron (Fe). Of the 77 fluoride determinations made in the Project area from Paluxy Formation ground-waters, 25 determinations or 32 percent were above the EPA-TSHD maximum allowable level of 1.6 mg/l for the Project area. Of the 111 fluoride determinations made from Twin Mountain Formation ground waters, 83 determinations or 75 percent were above the maximum allowable level of 1.6 mg/l. Approximately 31 iron determinations were made from

Table 5. Range and Average of Chemical Constituents and Properties of Ground Water from the Trinity Group Aquifer in the Project Area.

Constituent/Property	Concentrations			
	Paluxy Formation		Twin Mountains Formation	
	Range	Average	Range	Average
Silica (SiO_2)	1-76 mg/1	18 mg/1	4-40 mg/1	16 mg/1
Iron (Fe)	0-3.6 mg/1	Not Deter.	0-9.4 mg/1	Not Determined
Calcium (Ca)	1-129 mg/1	4 mg/1	3-36 mg/1	6 mg/1
Magneisum (Mb)	0-24 mg/1	2 mg/1	1-56 mg/1	2 mg/1
Sodium (Na)	30-1,050 mg/1	304 mg/1	150-666 mg/1	373 mg/1
Bicarbonate (HCO_3)	122-695 mg/1	530 mg/1	185-640 mg/1	473 mg/1
Sulfate (SO_4)	21-1,711 mg/1	167 mg/1	19-940 mg/1	176 mg/1
Chloride (Cl)	16-307 mg/1	31 mg/1	28-740 mg/1	116 mg/1
Fluoride (F)	0.2-4.0 mg/1	1.6 mg/1	0.2-16.0 mg/1	1.8 mg/1
Nitrate (NO_3)	0-4.6 mg/1	0.5 mg/1	0-3.6 mg/1	0.4 mg/1
Total Dissolved Solids	257-3,008 mg/1	759 mg/1	420-2,002 mg/1	965 mg/1
Total Hardness as $CaCO_3$	4-423 mg/1	17 mg/1	8-230 mg/1	20 mg/1
Specific Conductance (Micromhos at 25° C)	451-5,280	1,161	510-3,108	1,598
pH	7.2-9.2	8.4	7.7-9.1	8.3

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Paluxy Formation ground waters. Approximately 4 determinations or 13 percent were above the EPA-TSHD maximum allowable level of 0.3 mg/l. Approximately 57 iron determinations were made from Twin Mountains Formation ground waters. Approximately 11 determinations or 19 percent were above the maximum allowable level.

The number of historical chemical analyses available in the Project area for the Trinity Group Aquifer have limited distribution in time and space. A reliable historical record of consistant chemical analyses data for the Trinity Group Aquifer is not available; especially during the 1940's 1950's and early 1960's, when the largest annual amounts of ground water withdrawals occurred. The limited distribution of analyses generally indicates that serious ground-water quality changes have not occurred in the heavily pumped areas of western Dallas County. However, the large historical ground-water withdrawal from the aquifer during the 1940's, 1950's and early 1960's in Tarrant and western Dallas counties reversed the hydraulic gradients of the aquifer to such an extent that currently, some saline-water encroachment is evident in Dallas County in some wells completed adjacent to the base of slightly saline water and adjacent to the aquifer's downdip extent (bad water line). This slow amount of saline-water encroachment will continue as long as current pumping water levels are sustained. If pumpage is increased, the rate of encroachment will increase.

Carrizo-Wilcox Aquifer

Ground-water quality of this aquifer is represented by only 10 chemical analyses of water samples taken in southeastern Hopkins County as part of the Department's Ground-Water Quality Monitoring Program. Results from these

analyses are given in Table 4. The most acute water quality problems with ground waters from the Carrizo-Wilcox Aquifer are high concentrations of iron and low pH. As indicated above, no iron determinations were made. However, representative chemical analyses of ground waters from Carrizo-Wilcox Aquifer wells in comparable areas of Wood County indicate iron concentrations as high as 2.2 mg/1 with 67 percent of the determinations above the EPA-TSHD maximum allowable level of 0.3 mg/1. Only one of the pH determinations in Table 4 was below 7.0 (6.2). However, representative analyses in comparable areas of Wood County indicate a range in pH of 4.0 to 7.5 with 50 percent of the pH determinations below 7.0. Currently, there is no large withdrawals or overdrafts of ground from the Carrizo-Wilcox Aquifer in southeastern Hopkins County; therefore, no saline-water encroachment is evident.

Woodbine Aquifer

Ground-water quality of the aquifer is represented by more than 250 chemical analyses of water samples taken in Collin, Dallas, and Kaufman counties. Results from these analyses are given in Table 5. The most acute water quality problems with ground waters from the Woodbine Aquifer are high concentrations of fluoride (F) and iron (Fe). Of the 232 determinations for fluoride, 154 determinations or 66 percent exceeded 1.6 mg/1 which is the EPA-TSHD maximum allowable for fluoride in the Project area. Of the 97 determinations for iron, 34 determinations or 35 percent were above the EPA-TSHD maximum allowable level of 0.3 mg/1. There is no evidence of significant saline-water encroachment in the Woodbine Aquifer in the Project area. However, this determination is based on available historical chemical analyses data which have limited distribution in time and space. A reliable historical

Table 4. Range and Average of Chemical Constituents and Properties of Ground Water from the Carrizo-Wilcox Aquifer in the Project Area.

Constituent/Property	Concentrations: Range	Concentrations: Average
Silica (SiO_2)	10-58 mg/1	28 mg/1
Iron (Fe)	Not Determined	--
Calcium (Ca)	5-81 mg/1	26 mg/1
Magnesium (Mg)	1-7 mg/1	3 mg/1
Sodium (Na)	4-121 mg/1	47 mg/1
Bicarbonate (HCO_3)	16-277 mg/1	88 mg/1
Sulfate (SO_4)	4-45 mg/1	19 mg/1
Chloride (Cl)	3-40 mgl	23 mg/1
Fluoride (F)	0.1-0.5 mg/1	0.2 mg/1
Nitrate (NO_3)	0.4-22 mg/1	4 mg/1
Total Dissolved Solids	110-330 mg/1	222 mg/1
Total Hardness as $CaCO_3$	19-226 mg/1	76 mg/1
Specific Conductance (Micromhos at 25°C)	108-578	349
pH	6.2-8.2	7.7

Table 5. Range and Average of Chemical Constituents and Properties of Ground Water from the Woodbine Aquifer in the Project Area.

Constituent/Property	Concentrations: Range	Concentrations: Average
Silica (SiO_2)	5-68 mg/1	13 mg/1
Iron (Fe)	0-6.5 mg/1	not determined
Calcium (Ca)	0-105 mg/1	4 mg/1
Magnesium (Mg)	0-35 mg/1	1 mg/1
Sodium (Na)	113-1,370 mg/1	425 mg/1
Bicarbonate (HCO_3)	165-1,219 mg/1	519 mg/1
Sulfate (SO4)	13-824 mg/1	297 mg/1
Chloride (Cl)	10-1,210 mg/1	91 mg/1
Fluoride (F)	0-5.7 mg/1	1.9 mg/1
Nitrate (NO_3)	0-31 mg/1	0.8 mg/1
Total Dissolved Solids	338-3,480 mg/1	1,155 mg/1
Total Hardness as $CaCo_3$	2-359 mg/1	14 mg/1
Specific Conductance (Micromhos at 25°C)	609-4,860	1,649
pH	6.9-9.2	8.3

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record of consistant chemical analyses data for the Woodbine Aquifer is not available; especially during the 1940's, 1950's, and early 1960's, when the largest annual amounts of ground water withdrawals occurred.

Nacatoch Aquifer

Ground-water quality of the aquifer is represented by only 26 chemical analyses of water samples taken in Delta and Hunt counties. Results from these analyses are given in Table 6. The 23 fluoride (F) determinations in Delta and Hunt counties indicate about 17 percent had concentrations which exceeded the EPA-TSHD maximum allowable level of 1.6 mg/l for the Project area. The available historical record of chemical analyses data is not sufficient to determine if saline-water encroachment has occurred in the Nacatoch Aquifer within the Project area.

POTENTIAL FOR GROUND-WATER DEVELOPMENT OUTSIDE THE PROJECT AREA.

The potential for additional ground-water development of the Trinity Group, Woodbine, and Nacatoch Aquifers in areas outside but adjacent to the Project area are not favorable. Additional development of these aquifers for export of water to help meet the demands of the Project area would cause the same economic and water quality problems demonstrated by the development of the aquifers within the project area; i.e., extreme pumping lifts, acute water-level declines, some saline-water encroachment, and undesirable concentrations of iron and fluoride.

Table 6. Range and Average of Chemical Constituents and Properties of Ground Water from the Nacatoch Aquifer in the Project Area.

Constituent/Property	Concentrations Range	Concentrations Average
Silica (SiO_2)	10-21 mg/1	12 mg/1
Iron (Fe)	0-0.3 mg/1	Not Determined
Calcium (Ca)	1-192 mg/1	3 mg/1
Magnesium (Mg)	0-9 mg/1	1 mg/1
Sodium (Na)	224-700 mg/1	261 mg/1
Bicarbonate (HCO_3)	318-886 mg/1	437 mg/1
Sulfate (SO_4)	1-186 mg/1	62 mg/1
Chloride (Cl)	19-580 mg/1	75 mg/1
Fluoride (F)	0-4.8 mg/1	0.6 mg/1
Nitrate (NO_3)	0-6.8 mg/1	0.7 mg/1
Total Dissolved Solids	413-1,717 mg/1	655 mg/1
Total Hardness as $CaCO_3$	2-56 mg/1	9 mg/1
Specific Conductance (Micromhos at 25°C)	820-2,840	1,033 mg/1
pH	7.9-9.1	8.6 mg/1

Development of additional ground-water supplies from the Blossom Aquifer in Fannin, Lamar, Red River, and Bowie counties for export to the Project area is also not favorable. The Blossom Aquifer is similar in characteristics and performance to the Nacatoch Aquifer, and is not a sufficient water supply in its area of occurrence (four counties mentioned above).

Significant but limited quantities of ground water are available for development from the Queen City Aquifer southeast of the Project area. However, ground water produced from this aquifer throughout east Texas usually has a high concentration of iron, and an unusually low pH. Representative chemical analyses of ground water from the aquifer in Wood County indicate the following:

1. Total Iron (Fe) Concentration

   Percent above 0.3 mg/1 - 60%

   Range of concentration - 0.05 to 4.5 mg/1

   Average concentration - 1.1 mg/1

2. pH Level

   Percent below 7.0 - 87%

   Range of pH values - 5.4 to 7.7

   Average pH value - 6.5

Environmental Protection Agency and Texas State Health Department recommended maximum levels (secondary standards established under the Federal Safe Drinking Water Act) for iron and pH for drinking water are 0.3 mg/1 and 7.0 or greater, respectively. Water produced from the Queen City Aquifer would have to be treated before it is used as a drinking water supply. This would add considerable cost to its proper development.

The nearest, significant, yet still limited source of ground water for possible export to the Project area would be the Carrizo-Wilcox Aquifer in Wood County

in a 10 square mile area about 2 to 6 miles south of Winnsboro. In this area, the Carrizo-Wilcox Aquifer has approximately 600 to 640 feet of sand thickness containing fresh water, and a potential total transmissibility of about 30,000 gpd/ft, which is for a 1,000 feet, properly constructed well fully penetrating the aquifer. The approximate depths to the top of the aquifer in the area range from about 90 to 240 feet. Approximate depths of static water levels would be about 80 to 110 feet. Properly constructed and developed wells in this area could yield about 300 gpm, and have specific capacities between 6 and 10 gpm/ft. However, representative chemical analyses of water from Carrizo-Wilcox Aquifer wells in Wood County indicate iron concentrations of about 0.1 to 2.2 mg/1, with 67 percent of the iron determinations above the EPA-TSHD maximum level of 0.3 mg/1. Also, these representative analyses indicate a range in pH of 4.0 to 7.5 with 50 percent of the pH determinations below 7.0. Under these conditions, most of the water produced from the Carrizo-Wilcox aquifer would have to be treated before conveying it to its point of use and the aquifer could only supply approximately 5,000 acre-feet annually on a sustained basis. Under current water use conditions, this is a sufficient annual supply for a city having a population of about 15,000 to 20,000. Also, the approximate supply is the quantity of ground water which the aquifer might supply under an ideal pattern of location and spacing of wells. The supply is subject to constraints imposed by water quality and economic problems related to undersirable water quality constituents or properties (namely high iron content and low pH), the great distances between location of supply and location of potential use, and the landowners' ownership of ground water. Also, a properly constructed and equipped 1,000 feet deep well would probably cost as much as $300 to $350 per foot at current

prices, thus making the cost of each well about $300,000 to $350,000. To obtain the approximate 5,000 acre-feet annual yield, approximately 10 properly located and spaced wells would be needed. The initial cost to properly construct and equip these wells could be as high as $3.5 million. This cost does not include the cost for land, energy to pump and distribute the water, distribution facilities, and treatment facilities.

SUMMARY

Historical and current performances and the characteristics of the aquifers and adjacent to the Cooper Lake and Channels Project area indicate that these aquifers are not capable of adequately providing long-term, dependable water supplies. Except for the Carrizo-Wilcox and Queen City Aquifers, all other aquifers in and adjacent to the Project area are depleted to such an extent that the maximum depths of water levels currently occur between 350 to more than 1,000 feet below the land surface. The Carrizo-Wilcox and Queen City Aquifers, which are currently not developed to their maximum potentials within and adjacent to the Project area, have very limited quantities of available ground water which if developed would have inherent water quality problems related to high iron content and low pH.

The North Texas Municipal Water District (NTMWD) and its member and customer cities, the City of Irving, and the Sulphur River Municipal Water District (SRMWD) and its potential member and customer cities are looking to the Cooper Lake and Channels Project for their next increment of water supply. The ground-water resources which are physically available to the NTMWD and the City of Irving within and adjacent to their service areas from the Trinity Group,

Woodbine, and Nacatoch Aquifers, are not now dependable supplies, and certainly should not be considered as dependable sources of water in the future. The same situation exists between the SRWMD and its potential member and customer cities and the limited ground water resources of the Trinity Group, Blossom, Carrizo-Wilcox, and Queen City Aquifers in and adjacent to the District's potential service area.

Appendix D
Exhibit 3
26

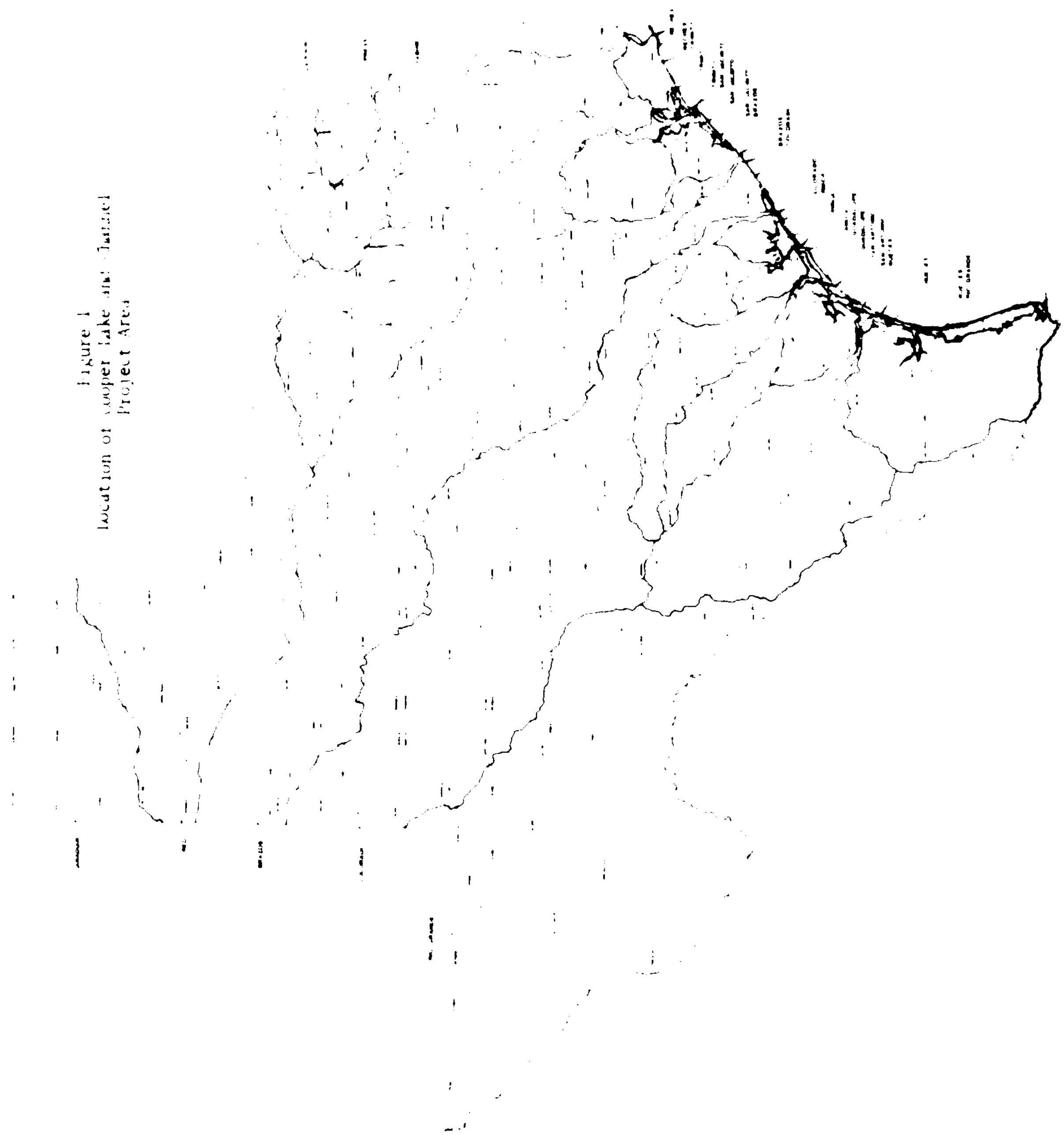
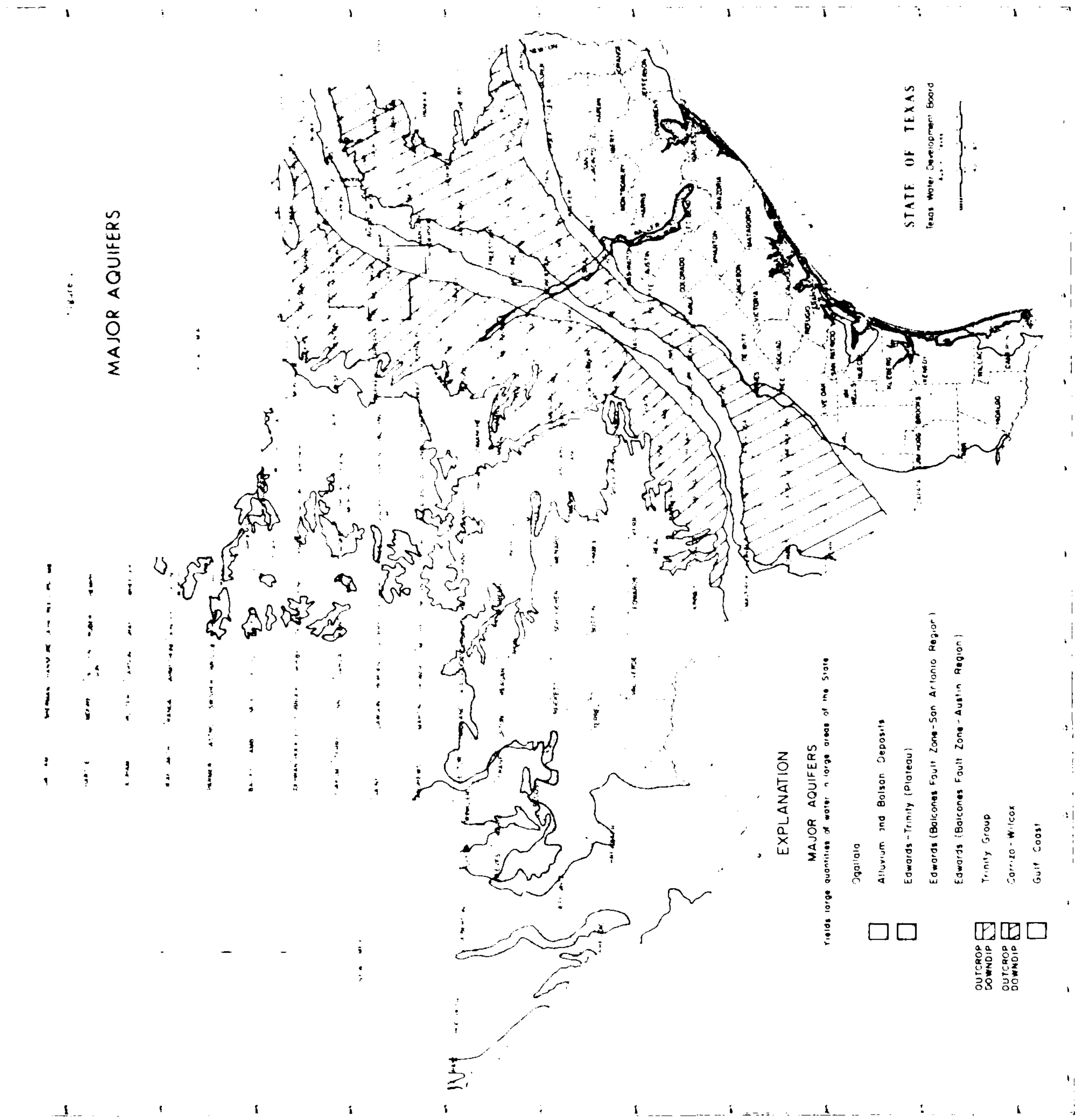
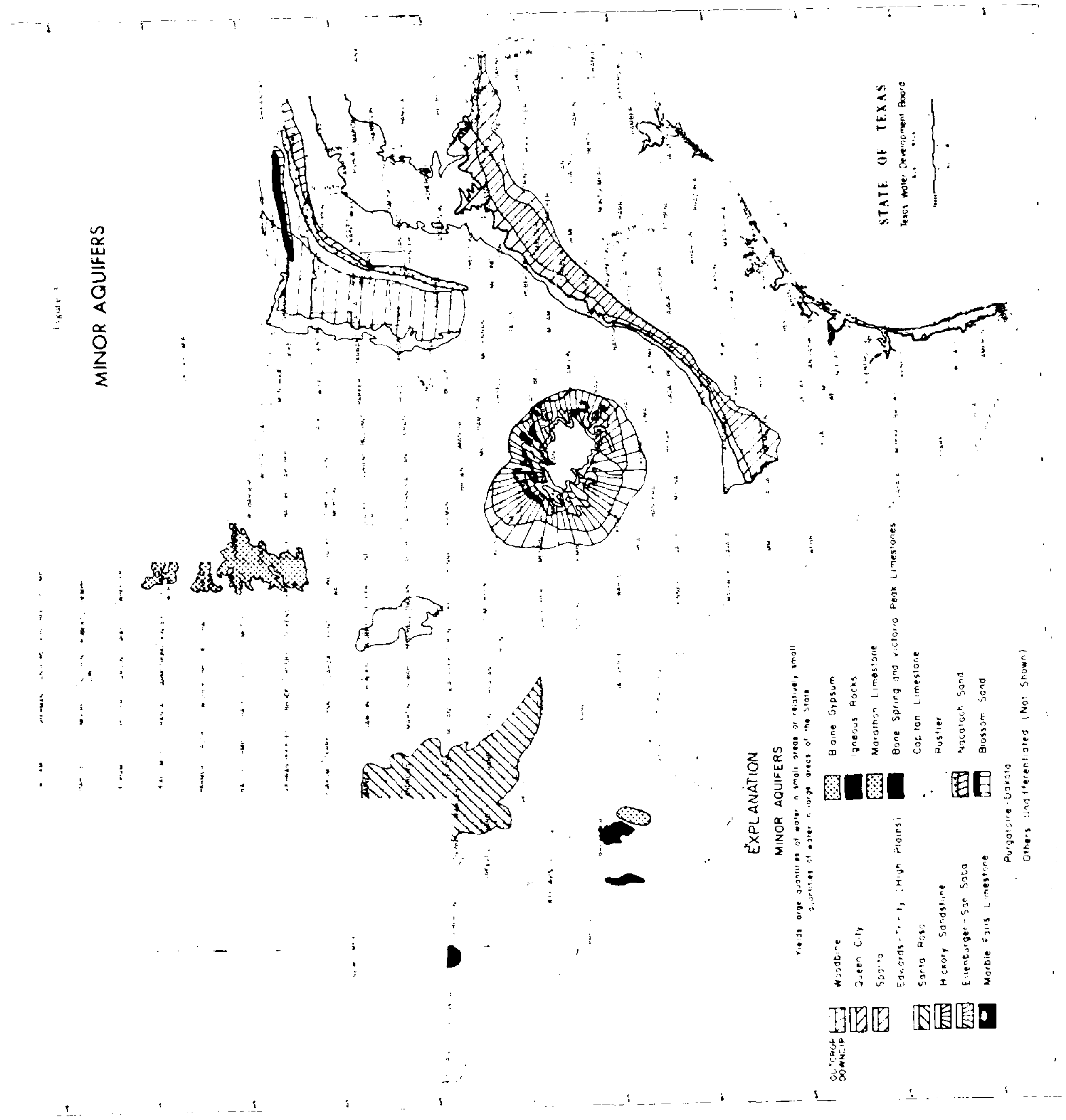


Figure 1
Location of Cooper Lake and Tunnel
Project Area



Appendix D
Exhibit 3


MINOR AQUIFERS
EXPLANATION
MINOR AQUIFERS
Yields large quantities of water in small areas or relatively small quantities of water in large areas of the State
OUTCROP
DOWNDIP
Woodbine
Queen City
Sparta
Edwards-Trinity (High Plains)
Santa Rosa
Hickory Sandstone
Ellenburger-San Saba
Marble Falls Limestone
Blaine Gypsum
Igneous Rocks
Marathon Limestone
Bone Spring and Victorio Peak Limestones
Capitan Limestone
Rustler
Nacatoch Sand
Blossom Sand
Purgatoire-Dakota
Others Undifferentiated (Not Shown)
STATE OF TEXAS
Texas Water Development Board

APPENDIX E

SECTION 404 CONSIDERATIONS
AND
COORDINATION RECORD

APPENDIX E

COMPLIANCE WITH SECTION 404

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APPENDIX E

COMPLIANCE WITH SECTION 404, CLEAN WATER ACT (PL 95-217)

Preface. The discharge of dredged or fill materials into waters of the United States is regulated by the Secretary of the Army, acting through the Chief of Engineers, under authority of Section 404 of the Clean Water Act. Federal projects, including those authorized by Congress for construction by the Corps of Engineers in its civil works program, are required to comply with the requirements of Section 404 the same as any private individual or State or local government agency would in obtaining a Section 404 permit through the regulatory program. These requirements are:

o Evaluate effects of the discharge under the Section 404(b)(1) guidelines developed by EPA (40 CFR 230, published in 5 September 1975 Federal Register) and make certain determinations and findings.

o Provide for public notice and opportunity for public hearings (Section 404(a)).

o Provide EPA the opportunity to veto the selection of disposal sites or restrict use (Section 404(c)).

The Corps does not issue itself a permit for a civil works project but presents evaluations, conclusions, determinations, and findings in a report or statement of findings to authorize the discharge. Section 404(r) of the Clean Water Act exempts discharges as part of the construction of a Federal project if information on the effects of the discharges, including application of guidelines developed by the Administrator, Environmental Protection Agency (EPA), is included in an environmental statement submitted to Congress prior to the authorization or prior to appropriation of funds for the discharge.

Subsequent to filing the final EIS for the Cooper Lake and Channels Project, and prior to issuance of the Memorandum Opinion detailing the deficiencies in the final EIS, the Corps of Engineers initiated the procedures required by Section 404 to authorize discharges of dredged or fill material associated with the final EIS recommended plan (Reservoir and Levees). In February 1978, a public notice was issued for the purpose of developing facts and interagency or public recommendations concerning these discharges required by the recommended plan. The notice expressed the Corps' intent not to proceed further than the publication of the notice and receipt of comments pending a favorable ruling from the court lifting the 1971 injunction. Ten letters were received in response to the public notice. No requests for a public hearing were received and none was held. A water quality certificate pursuant to Section 401 of the Clean Water Act was received from the Texas Department of Water Resources on March 10, 1978, for the final EIS recommended plan.

In accordance with the Section 404 public notice issued on 24 February 1978, and the permanent enjoining of further work on the Cooper Lake and Channels Project by the Court on December 8, 1978, the Section 404 process was interrupted and reevaluated in light of this ruling. Significant changes in Federal policy regarding projects in wetlands (E.O. 11990) and flood plains (E.O. 11988) have occurred since the final EIS was filed on the Cooper Lake and Channels Project. While the Reservoir and Levees plan recommended in the final EIS is still economically feasible, this plan would result in a substantial impact on wetlands in the Sulphur River basin. Most of these impacts are indirect, or induced impacts, of flood protection provided by the downstream levees and channels. Based on the policy expressed in these executive orders, guidance pertaining to the Section 404 program, the Chief of Engineers policy on wetlands, and policy expressed by the Environmental Protection Agency and US Fish and Wildlife Service on recent private actions in the flood plain regulated under Section 404, the Corps no longer feels the recommendation of further levee and channel work as a Federal interest is justified.

The Section 404 considerations and coordination record is modified in this appendix to reflect deletion of the downstream levees and channels as a proposed disposal action. The disposal actions required by the reservoir feature of the Reservoir and Levees plan presented in the public notice issued 24 February 1978 are the same for the Reservoir Only plan now recommended in the supplemental EIS.

While technical aspects of Section 404 compliance have been met previously, with the exception of a Statement of Findings, comments received on the supplemental EIS have been considered in making findings and determinations in this final supplemental EIS.

SECTION 404 CONSIDERATIONS

COOPER LAKE & CHANNELS, TEXAS

PART I - INTRODUCTION

All Federal projects which are recommended for construction by the Corps of Engineers, and which include the discharge of dredged or fill material into the waters of the United States, must be reviewed for compliance with Section 404 of the Clean Water Act. This review is made in accordance with applicable Corps regulations concerning policies, practices, and procedures developed pursuant to Section 404 of the Clean Water Act and Section 103 of the Marine Protection, Research, and Sanctuaries Act of 1972; wetland policies established by the Chief of Engineers; and Executive Order 11990, Protection of Wetlands. The review is also made in accordance with Environmental Protection Agency Guidelines, Title 40, Code of Federal Regulations (CFR), Part 230, for evaluating the discharges of dredged or fill material into the waters of the United States.

PART II - BACKGROUND

A. Project Authority.

1. Authorization. Congressional authorization for the construction of the Cooper Lake and Channels, Texas, Project is contained in the Act approved 3 August 1955 (Public Law 218, Chapter 501, 84th Congress, 1st Session). The Act authorizes the construction of Cooper Lake and channel and levee improvement ". . . substantially in accordance with the construction plans recommended in the report of the Chief of Engineers in House Document Numbered 488, Eighty-third Congress, 2nd Session. . ."

2. Status of Litigation. Construction of the project began in 1958 and continued into 1971. In June 1971 the US District Court for the Eastern District of Texas, in civil action No. 549 acting on a motion for preliminary injunction by the Texas Committee on Natural Resources, et al., enjoined further construction on the project until an environmental impact statement (EIS), as required by the National Environmental Policy Act, was filed with the President's Council on Environmental Quality (CEQ). The Court, however, permitted planning, real estate acquisition, and other nonconstruction activities associated with the project to proceed. The final EIS was filed with CEQ on 24 June 1977 and the trial on its adequacy was held in the US District Court for the Eastern District of Texas on 9 through 17 January 1978. On 8 December 1978, Justice William Wayne Justice issued a Memorandum Opinion permanently enjoining construction of the Cooper Lake and Channels Project until certain deficiencies noted in the final EIS were corrected. The Memorandum Opinion detailed these deficiencies which have now been addressed in a draft supplemental EIS.

B. <u>Project Description</u>. The authorized project consists of a multipurpose lake, levees, and channel improvements in the Sulphur River basin of Northeast Texas to provide flood control, water supply, and recreation over a economic life of 100 years.

1. <u>Cooper Dam</u>. The earthfill dam and spillway works will be located at mile 23.2 of the South Sulphur River near Cooper, Texas. The lake will contain storage space for flood control (131,400 acre-feet), municipal and industrial water supply (273,000 acre-feet), and a reserve for sedimentation (37,000 acre-feet). The flood control storage space will reduce flood flows below the dam and will permit a possible future conversion of 120,000 acre-feet of existing storage space in Wright Patman Lake from flood control to water supply. The decision whether or not to implement this storage space conversion, however, will be a future determination to be made in accordance with the provisions of the National Environmental Policy Act of 1969. The following facilities will be associated with the construction of Cooper Dam.

a. An earthen dam embankment 15,882 feet long with a hard surface public use road crossing the dam for a majority of its length on a berm adjacent to the downstream toe of the dam. The dam will average 40 feet in height with a maximum height of 73 feet.

b. A concrete spillway 266 feet long with accompanying inlet and outlet channels. A concrete bridge will span the service spillway and will be a part of the public use road. The service spillway will be used for both the normal operational releases and the design flood releases from the lake.

c. An earthen emergency spillway 4,200 feet long with the hard surface public use road traversing the spillway crest.

d. A tailwater fishery parking area adjacent to the service spillway outlet channel and an administration complex at the north dam abutment consisting of a visitor's center and maintenance area, an overlook building, and a boat launch and parking area.

e. Minor utility relocations, the relocation of Tucker Cemetery out of the dam site, and the raising of a portion of Dawson Cemetery.

f. An access road, approximately 1.1 miles in length, from the south dam abutment to State Highways 19 and 154 west of Tira, Texas. This new road will be used for construction access and then repaired and incorporated into the State highway system along with the public use road across the dam.

g. An access road (Farm-to-Market Road 1529) approximately 1.8 miles in length, from the north dam abutment to its junction with State Highway 154 east of Cooper, Texas. This existing road will be used for construction access and then upgraded and incorporated into the State highway system along with the public use road across the dam.

2. Cooper Lake Development. Development of the lake will require the clearing of approximately 15,900 acres of land within the lake area which will be inundated including approximately 700 acres of land which will be cleared and graded for fish seining areas. Minor utilities relocations within the lake area will be required. Two cemeteries, Friendship and Liberty Grove, will be relocated out of the lake area. Thirty-three hundred acres of land at seven sites will be available for recreational development. Adequate roads and parking facilities will be developed for visitors. Other facilities which include boat launching ramps, trails, picnicking and camping areas, potable water supplies, comfort stations, shelters, beaches, and safety features will be provided based on the number of annual visitors. Facilities will be so located as to utilize and enhance the natural beauty of all sites. Landscaping will be accomplished to complement the surrounding natural beauty and to establish vegetative growth over the construction areas. The construction of Cooper Lake will require the relocation or alteration of 1.1 miles of Farm-to-Market Road 1528, including two bridges, and the construction of a 0.1 mile segment of road near the Doctors Creek Recreation Area. Cooper Lake construction may also require the degrading of some existing levees within the lake area.

3. Levees and Channels Upstream of the Lake. The authorized project provides for the improvement of 7.4 miles of agricultural levees and the excavation of 18.4 miles of realined river channel together with the clearing of a floodway along the realined channel on the South Sulphur and Middle Sulphur Rivers. This work was begun in 1958 and completed in 1959.

4. Levees and Channels Downstream from the Lake. The authorized project provides for the enlargement, extension, and construction of 66.8 miles of levees and the excavation of 25.4 miles of realined channel together with the clearing of a floodway along the realined channel on the Sulphur, South Sulphur, and North Sulphur Rivers, and on Cuthand and Brushy Creeks. Of this, approximately 40 miles of levee work and 19 miles of channel work have been completed. The currently recommended plan deletes the remaining downstream channel and levee work. This change in the project plan is described in the draft supplemental environmental statement.

a. Completed Work. Construction of the levee and channel improvements downstream of Cooper Lake commenced in September 1959 and continued intermittently as rights-of-way and funds became available until April 1964. During this time, the following work was accomplished:

(1) Cuthand Creek - 15.1 miles of channelization and 13.9 miles of levee work (levees 4LC and 5LC).

(2) Sulphur River - 11.9 miles of levee work (levees 1LS and 1RS).

(3) Brushy Creek - 0.8 mile of channelization.

(4) North Sulphur River - 9.6 miles of levee work (levee 1RN).

(5) South Sulphur River - 4.5 miles of levee work (levee 5RSS).

Project modifications and spending limitations prevented construction of levees and channels between April 1964 and February 1971 at which time a contract was awarded for levee and channel work downstream from US Highway 271. In June 1971, further construction on the project was enjoined as discussed earlier. The levee and channel contract in progress was, therefore, terminated. Before the preliminary injunction was ordered, 8.7 miles of floodway clearing and 3.0 miles of channelization within the cleared floodway had been accomplished.

b. Remaining Levee Work. The only remaining levee work now proposed consists of completion of the levee (Ext 4RSS Spur) immediately below Cooper Dam which is needed in conjunction with the outlet channels to continue to protect existing levee protected lands.

Since the present levee 4RSS will be cut by the service spillway outlet channel, an extension spur levee (4RSS Spur) approximately 5,000 feet long will be alined parallel to and east of the spillway outlet channel. This levee will require placement of about 25,000 cubic yards of fill material.

C. Disposal Areas and Quantity of Materials.

1. Cooper Dam. The construction of the dam and spillways as previously described, will involve the placement of approximately 6,360,000 cubic yards of fill material on 410 acres of land within the dam site. This material has been laboratory tested and in general classified as principally fat and lean clays with a few silty strata. Prior to the placement of the fill material, approximately 197,000 cubic yards of top material will be stripped from the damsite and placed either in the borrow areas, or in the 40-acre disposal area shown. Approximately 2,482,000 cubic yards of additional material will be excavated from the damsite. The latter excavated material will be used in the dam embankment to the maximum extent possible, and the portion that is unsuitable for that purpose will be placed in the borrow areas or in the disposal area shown. Of the total 450 acres within the damsite and the disposal area, approximately 60 acres are considered to be wetlands because they are periodically inundated bottomland hardwoods adjacent to the South Sulphur River, with vegetation typically adapted to saturated soil conditions for growth and reproduction; namely, cedar elm, green ash, boxelder, swamp privet, bitter pecan, buttonbush, and black willow.

The relocation of Farm-to-Market Road 1528 is necessary to avoid inundation by the lake and will involve the construction of bridges over Johns Creek and Doctors Creek and the construction of nearly a mile of roadway embankment. This work will involve the placement of approximately 190,000 cubic yards of fill material, similar to that previously described, for the roadway embankment on approximately 20 acres of wetlands, similar to those

described above, within the Cooper Lake area. The fill material will be obtained from a nearby borrow area which lies within the boundaries of the lake.

2. Remaining Levee Work Downstream from the Lake. The completion of the remaining downstream levee work will require the placement of approximately 25,000 cubic yards of dredged or fill material, similar to that described in paragraph C-1 above.

The areas within the levee right-of-way were probably wetlands characterized by bottomland hardwoods as described in paragraph C-1 above prior to protection through construction of levee 4RSS. The right-of-way is now completely cleared and is no longer considered a wetland area.

Fill material for the construction of the levee will be obtained from borrow areas within the right-of-way boundaries and from the material excavated in the construction of the dam.

E. Properties Adjacent to the Disposal Sites. Properties immediately adjacent to the damsite consist of both cleared and wooded areas. Approximately 85 percent of the property is cleared and used for livestock grazing while approximately 15 percent consists of bottomland hardwoods.

F. Dredging by Others. There are several known, related activities involving the disposal of dredged or fill material in the Sulphur River flood plain by private individuals. Any such activity which would impact the waters of the United States would require a permit from the US Army Corps of Engineers under Section 404 of the Clean Water Act. A full review would be conducted in each instance to determine whether the activity best serves the public interest.

G. Cultural Resource Considerations. The National Register of Historic Places and monthly supplements thereto have been consulted and there are no National Register properties to be affected by the project. In accordance with the provisions of 36 CFR 800, the proposed Cooper Lake Archeological District has been determined to be eligible for inclusion in the National Register of Historic Places. This district encompasses portions of all natural environmental zones adjacent to the South Sulphur River and includes nine prehistoric archeological sites. These sites have been evaluated or excavated by Southern Methodist University, beginning in 1970 and continuing through 1975. The Advisory Council on Historic Preservation, in accordance with the provisions of 36 CFR 800, has been afforded the opportunity to comment on this undertaking, and the State Historic Preservation Office has concurred in a determination of no adverse effect on the archeological district.

Specifications for all work on the project will provide for preservation of any items of apparent historical or archeological interest which may be discovered during the course of construction activities.

H. Project Coordination.

1. General. Coordination with interested Federal and non-Federal agencies has been accomplished during both the preauthorization and post-authorization planning process.

2. Draft Environmental Impact Statement. In accordance with the National Environmental Policy Act of 1969, the draft environmental impact statement was filed with the President's Council on Environmental Quality on 10 June 1976. On 31 July 1976, a public meeting was held on the East Texas State University campus to discuss the environmental statement and to insure widespread exposure of its contents. Of the nearly 650 people in attendance at the meeting, 55 delivered oral statements. Those who presented statements included two members of the US House of Representatives; a representative of the Governor of Texas; various State senators and representatives; representatives of various State agencies, State insitutions, and environmental/conservation groups; landowners; and other public interest groups. Nearly unanimous support of the total authorized plan was evidenced at the meeting. Of the 55 speakers at the meeting, three (Edward C. Fritz, Chairman of the Texas Committee on Natural Resources; Howard Saxion, Inland Conservation Chairman of the Lone Star Chapter of the Sierra Club; and Lel nd Womack, resident of the Sulphur River basin) expressed opposition to one or more features of the authorized plan.

3. Final Environmental Impact Statement. Through the written comments submitted during coordination and the oral testimony at the public meeting, two distinct issues surfaced: (1) the need for an adequate supply of surface water and downstream flood control, as stressed by area residents and governing bodies and (2) the opposition to a channel as a means of providing downstream flood control, as stressed by environmentally concerned agencies, groups, and individuals. Based on these observations, the decision was made to abandon most of the remaining channel feature of the plan presented in the draft environmental impact statement and to select the alternative, "reservoir and levees plan." On 24 June 1977, the final environmental impact statement presenting the selected "reservoir and levees plan" was filed with the President's Council on Environmental Quality and notice to this effect appeared in the Federal Register on 1 July 1977.

4. Public Notice. A public notice, in accordance with the provisions of Section 404(a) of the Clean Water Act was issued on 24 February 1978 with comments and/or a request for a public meeting due not later than 27 March 1978. Comments were received from the Lone Star Gas Company, the Texas Department of Water Resources, the Arkansas Game and Fish Commission, and the US Fish and Wildlife Service of the Department of the Interior. Additionally, the Budget and Planning Office of the Office of the Governor of Texas, forwarded comments of the following State agencies: Texas Department of Health, Texas Air Control Board, Texas Department of Water Resources, General Land Office, State Department of Highways and Public Transportation, and Texas Parks and Wildlife Department. These comments

were officially responded to and are discussed in Attachment A. Copies of the letters of comments and the official responses are contained in Attachment B. No request for a public meeting was received and on 13 April 1978, a news release was made to announce that no public hearing would be held and that preparation of this statement of findings would commence with completion pending the decision of the Federal District Court.

5. Supplemental EIS. After issuance of the Memorandum Opinion on December 8, 1978, enjoining further construction of the Cooper Lake and Channels Project pending correction of noted deficiencies, the Corps commenced additional studies leading to preparation of a supplemental EIS. These studies and recent changes in Federal policy regarding flood plains and wetlands have led to a recommendation that the remaining downstream channel and levee construction be deleted from the recommended plan. The draft supplemental EIS was circulated for comment, and the Section 404 determinations and findings for the reservoir only plan as modified during coordination are included in the final supplemental EIS.

PART III - EVALUATION

A. General. According to applicable regulations, Federal projects involving the disposal of dredged or fill materials into navigable waters at a specified disposal site will be evaluated by application of the Environmental Protection Agency guidelines of 5 September 1975 as developed by the Administrator, Environmental Protection Agency, in conjunction with the Secretary of the Army pursuant to Section 404(b) of the Federal Water Pollution Control Act. These guidelines are contained in 40 CFR 230. Also, through the provisions of the Clean Water Act, Federal agencies must comply with applicable State requirements for such projects. In the case of this project, this requirement is to obtain a water quality certification from the State of Texas. This certification was granted by the Texas Department of Water Resources on 10 March 1978 as discussed in Attachment A.

B. Physical and Chemical-Biological Interactive Effects.

1. Physical Effects. As described in 40 CFR 230.4-1(a), physical effects on the aquatic environment include the potential destruction of wetlands, impairment of the water column, and the covering of benthic communities. Other physical effects include changes in bottom geometry and substrate composition that cause subsequent alterations in water circulation, salinity gradients, and the exchange of constituents between sediments and overlying water with subsequent alterations of biological communities. As described in Part II, paragraph C - Disposal Areas and Quantity of Materials, above, approximately 60 acres of wetlands in the dam site will be used for the placement of fill. The construction of the

dam will significantly alter the immediate terrestrial ecosystem. After construction, the downstream face of the dam will be seeded with Bermuda grass; however, a return to higher stages of succession will not be allowed. The remaining physical effects described in the guidelines relate to the aquatic environment which is impacted to only a minor degree by the placement of fill material. This would include the South Sulphur River bottom at the dam site which amounts to only about 0.1 acre of water bottom.

2. Chemical-Biological Interactive Effects. As indicated in 40 CFR 230.4-1(b), these effects are very difficult to predict and the evaluation of these effects need not be carried out if: "(a) The material proposed for discharge is substantially the same as the substrate at the proposed disposal site; (b) The site from which the material proposed for discharge is to be taken is sufficiently removed from sources of pollution to provide reasonable assurance that such material has not been contaminated by such pollution; and (c) Adequate terms and conditions are imposed on the discharge of dredged or fill material to provide reasonable assurance that the material proposed for discharge will not be moved by currents or otherwise in a manner that is damaging to the environment outside the disposal site." The material proposed for discharge is essentially the same as, and in some cases, identical to the substrate at the proposed disposal site. The sites from which the material proposed for discharge is to be taken are not subject to any known pollution, and there is not reason to expect that these sites have been contaminated by pollutants in the past. The conditions imposed on the use of the proposed disposal sites as described in Part II, paragraph C - Disposal Areas and Quantity of Materials, above, are designed to protect the environment outside the disposal site. In view of the above, no evaluation of the chemical-biological interactive effects has been performed.

C. Water Quality Considerations. The placement of the fill material during the construction process is designed so as to minimize the contact between this material and the adjacent water. The vast majority of the material will be placed in areas away from the river and in such a manner that the material will not enter the stream. Only very minor amounts of dredging will be accomplished in the natural channel and even that will be done utilizing land based equipment. Thus, although the construction phase of the project will produce several water quality impacts, these will be localized and of short term. These will include: (1) increased turbidity, (2) reduction of dissolved oxygen, (3) minor releases of metals to the water column, and (4) a general warming of the surface waters due to the absorption of radiant energy by the suspended particles. The long term water quality effects of the project are discussed in the final environmental statement, April 1977. The Texas Department of Water Resources on 10 March 1978 issued a water quality certification for the project.

D. Considerations Relating to Degradation of Water Uses at Proposed Disposal Sites.

1. Municipal Water Supply Intakes. The three small, connected ponds just downstream of the emergency spillway of Cooper Dam serve as the source of the municipal water supply of the city of Cooper, Texas, and are known as City Lakes. The City Lakes will be acquired as part of the fee purchase area for Cooper Lake. In 1976, the acquisition cost of the lakes was estimated based on the cost for Cooper to develop an alternate water supply source for use until water is available in Cooper Lake. Due to drought conditions in 1978, a pipeline was constructed to Sulphur Springs which can supply Cooper with a significant portion of their water supply needs on an interim basis. By provisions of the construction plans and specifications, no construction activity will be allowed within the watershed of City Lakes unless this interim water supply system for the city of Cooper is operational. At that time, City Lakes will no longer be required and the remaining features of Cooper Dam may be completed. No other public water supply intakes will be affected by the construction work.

2. Shellfish. There are no known areas of concentrated shellfish production within the project area. Furthermore, only approximately 0.1 acre of water bottom will be directly affected by the placement of fill material on them. Therefore, the effects of project construction on shellfish are considered negligible.

3. Fisheries. The bulk of the disposal site is located on land areas well removed from the natural streams. Only about 0.1 acre of water bottom will be directly affected by the placement of fill material on them. As described in Part II, and as discussed in Attachment A in the responses to the various comments received, particularly those of the Texas Department of Water Resources, measures will be employed to minimize the effect of the use of disposal areas on the aquatic ecosystem. The impact of the proposed disposal activities on fisheries resources is considered minor. The long term effects of Cooper Lake on fisheries resources is discussed in the final environmental statement, April 1977.

4. Wildlife. The principal direct effect of the disposal activities on wildlife resources will be the alteration of the character of approximately 455 acres of land, including approximately 80 acres of wetlands, through the placement of fill material on it. All of the terrestrial invertebrates will be killed or forced to emigrate from these areas. Once construction is complete, however, this area, except the 40-acre disposal site within the reservoir area, will again support a diversity of invertebrates. Essentially all reptiles and amphibians that are likely to be affected by construction features are either closely associated with or dependent on the existing stream bottoms. Since only about 0.1 acre of water bottom will be directly affected by the placement of fill material on them, the effects of the construction activities on these species is considered minor. Many of the arboreal lizards such as the green anole, five-lined skink, broad-headed skink, Texas spiny lizard, and the fence lizard will be reduced by clearing, but all are expected to remain common. The birds that are most likely to be affected by the loss of the hardwoods, due directly to project construction, are the arboreal nesters. These

include the sparrows, cuckoos, woodpeckers, warblers, vireos, flycatchers, thrashers, orioles, mockingbirds, kinglets, numerous birds of prey, and two game birds, the mourning dove and the wood duck. Species that depend on moist, woodland areas for feeding will also be adversely affected. These include the heron, ibis, egret, bittern, belted kingfisher, and woodcock. Waterfowl, especially the wood duck, that depend heavily on mast producing hardwoods for food would be decreased. Significant reductions are expected in localized populations of species which prefer moist bottomland hardwoods, due to lake construction, but not directly from the disposal site. Species such as the beaver, mink, river otter, gray squirrel, swamp rabbit, and white-tailed deer will be adversely affected. Although these reductions in bird and mammal populations can be expected to occur on the disposal site and the entire area affected by the lake, the absolute magnitude of the wildlife losses occasioned by the disposal fill material is not felt to be overwhelming.

5. Recreation Activities. As described in Part II and as discussed in Attachment A in the responses to the various comments received, particularly those of the Texas Department of Water Resources, measures will be employed to minimize the effect of the use of the disposal areas on the nearby water bodies. Methods will be employed to minimize any increase in turbidity which would reduce the numbers and diversity of fish or cause a significant aesthetically displeasing change in the color, taste, or odor of the water. The same applies to the release of nutrients from the fill material to prevent eutrophication, the degrading of aesthetic values, and impairment of recreation uses. No known recreation involving physical contact with water occurs in the area of project construction. No oil or grease in harmful quantities as described in 40 CFR 110 will be released into the water bodies within the construction area. Due to the limited direct impact on water bottoms, the recreation losses associated with the use of the disposal areas are primarily restricted to big game hunting, small game hunting, waterfowl hunting, nonconsumptive recreation, and harvest of furbearers. These losses are based essentially on the loss of bottomland hardwoods. Other recreational opportunities currently afforded by the Sulphur River basin are limited. Natural areas and water bodies do not possess characteristics which attract large numbers of recreationists or encourage recreation facility development. The undeveloped topographic and geologic features in the region do not constitute major recreational attractions. Thus, the potential recreation opportunity is not realized, and the impact of the use of the disposal areas on the recreational activities of the area is considered minor.

6. Threatened and Endangered Species. The range of the alligator extends into the Sulphur River basin, but local populations are unknown. The overall project will decrease the amount of wetland habitat available, thereby decreasing populations which may be present now, and hinder any restocking efforts in the future. The project will not adversely affect any known critical habitat for any threatened or endangered species.

7. Benthic Life. Approximately 0.1 acre of water bottoms will be used for the placement of fill material. Therefore, the effect of this activity on benthic life is considered minor.

8. Wetlands and Size of Disposal Site. Of the total of approximately 455 acres of land proposed for use in the placement of fill material, approximately 80 acres are considered to be wetlands as described in Part II. Of the 80 acres of wetlands, 60 acres will be affected by Cooper Dam and 20 acres by Farm-to-Market Road 1528.

9. Submerged Vegetation. Since only about 0.1 acres of water bottom will be covered with material during construction, the resulting destruction of submerged vegetation is deemed insignificant.

E. Conclusions, Findings, and Determinations. Based on information included in this Section 404(b)(1) evaluation, the final EIS and this final supplemental EIS, and coordination accomplished through distribution of the public notice dated 28 February 1978 and this final supplemental EIS, the discharge sites for the Cooper Lake Project have been specified through application of the Section 404(b)(1) guidelines. Appropriate measures have been identified and incorporated into the recommended plan to minimize adverse impacts on the aquatic environment as a result of the discharge. Consideration has been given to the need for the proposed discharge, the availability of alternate sites and methods of disposal, and to water quality standards as are applicable by law.

ATTACHMENT A

DISCUSSION OF COMMENTS

RECEIVED BY THE DISTRICT ENGINEER

ON THE PUBLIC NOTICE

A. Lone Star Gas Company (6 March 1978).

Comment. "We cannot determine by the small maps or sketches showing the dams, reservoirs, and levees which of our pipelines will be affected by the proposed project; therefore, will you please furnish us with larger prints of all your proposed levees, channels, dams, and the area upon which water will be impounded to enable us to further consider the location of our pipelines in relation to the project. We will then be in a position to give further thought to this matter and not delay the project if it is approved by all governmental bodies."

Response. By letter dated 22 March 1978, four large prints showing Cooper Lake and the proposed levees and channels were transmitted to the Lone Star Gas Company.

Comment. "This letter is not intended to be used as a notice or demand for a public hearing. Lone Star Gas Company has no objections to the project provided it is reimbursed for all charges and expenses incurred in adjusting or relocating company facilities to conform to the project."

Response. Noted.

B. Arkansas Game and Fish Commission (13 March 1978).

Comment. "The ramifications of the proposed actions in this regard are largely of an interstate nature and accordingly, we shall defer primary review and comment prerogatives to the US Fish and Wildlife Service. Your office should be advised that the Arkansas Game and Fish Commission owns and operates a 16,000-acre Wildlife Management Area along the Arkansas portion of the Sulphur River and, more particularly, that wetlands within the boundaries of the Sulphur River Wildlife Management Area are considered to be critical habitat for the American Alligator - a Federally listed Endangered Species in Arkansas. By copy of this letter, we are advising the US Fish and Wildlife Service of our desire to cooperate as requested in the evaluation of your proposed activities."

Response. By letter dated 10 April 1978, this comment was noted.

C. Texas Department of Water Resources (10 March 1978).

Comment. "We believe there is reasonable assurance, subject to the qualifications and requirements checked on the attached pages, that the activity you have proposed will be conducted in a manner that will not violate applicable water quality standards. In making this certification, we limit it to those things under the jurisdiction of this agency according to the various statutes which this agency administers."

Response. By letter dated 10 April 1978, the certification was acknowledged under the interpretation that the certification covers Sections 61 and 67 of the Clean Water Act of 1977 (PL 95-217).

Comment. Certification Requirement: "The work must be done with the minimum production of turbidity in the waters where the work is taking place."

Response. The fill placing activity will be accomplished with land based equipment which will minimize the contact between bottom sediments and water thus minimizing the localized turbidity which will naturally occur during construction.

Comment. Certification Requirement: "Spoil must be placed in spoil areas approved by the United States Army Corps of Engineers and Texas Parks and Wildlife Department in such a manner as to minimize the runoff of spoil or highly turbid waters into adjacent waters."

Response. The disposal areas to be used have been coordinated with the Texas Parks and Wildlife Department. They have neither approved nor disapproved the proposed disposal areas. They stated in a letter dated 21 March 1978 that it would be beneficial to use all suitable material in the construction of levees and other structures. This will be done to the maximum extent practicable. The recommended plan now includes no further levee work except 4RSS Spur.

There will be a potential for some erosion of the remaining levee and disposal areas in the dam with a slight potential for an accompanying increase in the suspended solids concentrations of the Sulphur River. However, the construction plans and specifications pertinent to this aspect of work will require that the material deposited in disposal areas be placed and stabilized as quickly as possible to minimize erosion.

Comment. Certification Requirement: "This discharge of oil, gasoline, or other fuel or materials capable of causing pollution arising from your operations is prohibited."

Response. The construction specifications will specifically prohibit the pollution of lakes, ditches, rivers, bayous, canals, waterways, or reservoirs with fuels, oils, bitumens, calcium chloride, insecticides, herbicides, or other similar materials harmful to fish, shellfish or wildlife.

Comment. Certification Requirement: "Sanitary wastes are to be retained for disposal onshore in some legal manner."

Response. All work will be accomplished onshore and sanitary wastes will, by a provision of the construction specifications, be disposed of in a manner consistent with Federal, State, and local laws and regulations.

Comment. Certification Requirement: "During construction, adequate erosion control methods shall be used in order to minimize runoff and consequent elevations of turbidity in Coopers Lake."

Response. Through a telephone conversation on 1 May 1978 between Mr. J. C. Newell of the Texas Department of Water Resources and Mr. Stan Shelton of the New Orleans District, it was determined that "Coopers Lake" was meant to designate the City Lakes. These are three small connected ponds just downstream from the emergency spillway of Cooper Dam which serve as the source of the municipal water supply of the city of Cooper, Texas. City Lakes and adjacent land will be acquired as part of the fee purchase area for Cooper Lake. In 1976, the acquisition cost of the lakes was estimated based on the cost for Cooper to develop an alternate water supply source for use until water is available in Cooper Lake. Due to drought conditions in 1978, a pipeline was constructed to Sulphur Springs which can supply Cooper with a significant portion of their water supply needs on an interim basis. By provisions of the construction plans and specifications, no construction activity will be allowed within the watershed of City Lakes until this interim water supply system for the city of Cooper is operational. At that time, City Lakes will no longer be required and the remaining features of Cooper Dam may be completed.

Comment. Certification Requirement: "Areas devegetated during construction shall be replanted to the extent practicable after project completion, to avoid excessive erosion and the runoff of turbid waters to waters of the State."

Response. The construction specifications will require that all areas devegetated during construction will be covered with top soil, if necessary, and seeded and fertilized to control excessive erosion and runoff.

Comment: "No review of property rights has been made nor has any review been made as to the location of property lines, and especially, no review has been made as to the distinction between public and private ownership, and this certification may not be used in any way with regard to questions of ownership."

Response. Noted.

D. US Fish and Wildlife Service (20 March 1978).

Comment: "In a letter report dated September 3, 1976, the Fish and Wildlife Service recommended several mitigative measures for incorporation into the project, including installation of water control structures at the juncture of manmade and natural stream channels to divert normal streamflows through natural stream segments, increased low-flow releases from the reservoir, and establishment of an interagency study team to locate areas suitable for acquisition and management in compensation for project-induced wildlife losses. The plans outlined in the public notice do not incorporate any of these recommendations."

Response: The 3 September 1976 letter report referred to contained the following recommendations:

"1. An interagency study be initiated to locate the most suitable areas for acquiring the mitigation acreages required to compensate for project wildlife losses.

"2. The Corps of Engineers seek congressional authorization for mitigation lands acceptable to the Federal and State fish and wildlife agencies and the Corps of Engineers prior to the continuation of project construction.

"3. Mitigation lands be purchased in fee title prior to or concurrent with project completion in order that all lands selected for mitigation purposes be protected from induced clearing.

"4. Development, operation, and maintenance costs of managing mitigation lands be borne by the project.

"5. Water control structures be installed at the juncture of manmade and natural stream channels to divert normal streamflows through natural stream segments.

"6. Minimum instantaneous downstream releases be at least equal to or exceed the median monthly stream flow or 10 c.f.s., whichever is greater.

"7. A study be initiated to determine the impact and mitigation requirements of Wright Patman Lake enlargement prior to increasing water supply storage.

"8. Minimum instantaneous downstream releases below Wright Patman Lake be increased to 100 c.f.s. with higher flows from mid-October through December each year."

The first four recommendations deal with the acquisition of land to compensate for project related wildlife losses. An interagency study team made up of representatives of the US Fish and Wildlife Service, the Texas Parks and Wildlife Department, and the US Army Corps of Engineers is currently working on a mitigation report to be submitted to Congress. This report will address the amount and type of land appropriate for acquisition and the financial obligations relative to the acquisition and subsequent management. Mitigation recommendations are presented in the supplemental EIS. Recommendation 5 deals with design of downstream channel work which is no longer a part of the recommended project. Recommendation 6 deals with minimum streamflow releases from Cooper Lake. Cooper Lake, as described in the notice, is sized and designed for optimum water supply storage. All of the water supply storage space has been contracted for by local agencies since 1968. The design of Cooper Dam

and these contracts provide for a minimum downstream release from the lake of 5 c.f.s. This was approved, at the time, by the then Federal Water Pollution Control Administration. Thus, based on the existing contractual arrangements, 5 c.f.s. is the maximum low flow release rate consistently attainable from Cooper Lake. The possibility of releasing higher flows was investigated during the preparation of the supplemental EIS for Cooper Lake. Holding 5 percent of the flood pool is now recommended to increase the downstream flows to 30-50 c.f.s. when storage is available.

Recommendations 7 and 8 deal with the possible reallocation of storage space at Wright Patman Lake which is not a feature of the Cooper Lake and Channels, Texas, Project. The implementation of this possible reallocation is subject to a decision making process within the context of the National Environmental Policy Act of 1969. No final Government decision has yet been made. The development of mitigation requirements that might result from the implementation of this possible reallocation is an integral activity in the development of the environmental statement which must accompany any proposal for major Federal action concerning that possible reallocation. The contractual arrangements concerning the purchase of water from Wright Patman Lake provide for a minimum downstream release rate of 10 c.f.s. This was approved in 1967 by the then Federal Water Pollution Control Administration. Higher release rates have been obtained in recent years through the operation plan for Wright Patman Lake; however, these higher release rates are dependent on the yearly rainfall patterns and cannot be guaranteed.

As described above, the recommendations pertaining to the Cooper Lake and Channels, Texas, Project either are being studied or will be studied at the appropriate time. A discussion of these recommendations in the public notice was not felt to be appropriate.

Comment: "A meeting held on November 3, 1977, between personnel of our respective agencies resulted in an agreement to initiate a coordinated interagency effort for the purpose of preparing a mitigation report to be submitted for congressional authorization. We have subsequently been informed that the Memphis Corps District is in the process of examining the Ecological Planning and Evaluation Procedures' data used in the preparation of our September 3, 1976, report to determine the need for additional field studies. We have not yet been informed by Memphis District personnel whether these data are adequate for use in the preparation of the mitigation report."

Response: This comment is no longer pertinent. Interagency agreements were made to utilize as much field data as possible from the 1976 report and to conduct additional field sampling leading to a mitigation report with recommendations. Mitigation is now part of the project plan presented in the supplemental EIS.

Comment: "Our report of September 3, 1976, has adequately outlined our major areas of concern. Since a decision on the adequacy of the final EIS for this project is still pending in the US District Court for the Eastern District of Texas, we believe that comments on your proposed disposal plans would be premature at this time."

Response: The recommendations of the 1976 US Fish and Wildlife Service report are discussed elsewhere. In order to avoid any possible conflicts that the exercise of the procedures associated with the disposal plan might have engendered with respect to the then current injunction on construction of the project and with respect to the then currently unresolved litigation, the initiation of the Section 404 process was thoroughly coordinated with the US Attorney and Judge William Wayne Justice of the US District Court for the Eastern District of Texas. The Section 404 process constitutes an extension of the continuing environmental planning of the project and as such neither Judge Justice nor the US Attorney objected to the exercise of these procedures in advance of a ruling from the Court.

Due to the uncertainty surrounding the then pending decision of the Court, it was considered inappropriate to conclude the Section 404 process until a favorable ruling was received. Since the project was enjoined, the Section 404 aspects of the recommended plan are being reevaluated in light of recent policy changes and current conditions. The recommended plan in the supplemental EIS is now the reservoir only plan, and the US Fish and Wildlife Service may make appropriate comments as deemed necessary during coordination of the draft supplemental EIS.

Comment: "We strongly urge renewed interagency cooperation with the ultimate goal of establishing a plan for compensation of the adverse effects of the direct and indirect impacts to fish and wildlife resources associated with project implementation. Accordingly, we recommend that any decision on disposal of dredge or fill material be held in abeyance until a complete mitigation report has been submitted for congressional approval."

Response: The Corps of Engineers is committed to the preparation of a mitigation report which will present a plan to compensate for the fish and wildlife losses associated with the Cooper Lake and Channels, Texas, Project and to the submission of this report to Congress for authorization. The mitigation plan is presented in the supplemental EIS.

E. State of Texas, Office of the Governor, Budget and Planning Office (9 May 1978).

Comment: "A letter from this Office, dated March 23, 1978, transmitted State agency comments on the above referred public notice. Recent inquiry indicated that your office has not received this letter.

"Copies of the original comments are enclosed for your information."

Response: Noted.

1. Texas Department of Health (23 March 1978).

Comment: "Based on information contained in the Public Notice no adverse public or environmental health conditions are expected to result from the proposed construction. Relocation of public water supply and wastewater facilities may require plan and specification approval by the Texas Department of Health. If storm sewer and drainage facilities are properly designed, constructed, and maintained, it is expected that habitats for mosquito breeding will be minimal."

Response: Noted.

2. Texas Air Control Board (23 March 1978).

Comment: "We have reviewed the above cited document and have no further comments to add to those of our initial response of the draft environmental statement of June 23, 1976, relative to this project. We do reiterate that any outdoor burning should be done in accordance with the Rules and Regulations of the Texas Air Control Board."

Response: The comments of the Texas Air Control Board on the draft environmental statement of 23 June 1976 follow:

"We have reviewed the above cited document. Although there will be some temporary, localized effects during construction due to dust and machinery exhaust, we believe this will not significantly affect the overall ambient air quality. Additionally, there will be motor vehicle exhaust emissions associated with the one and a half million visitors anticipated annually. Any adverse air quality effects from these emissions could be discussed. Any outdoor burning should be done in accordance with the Rules and Regulations of the Texas Air Control Board."

The construction specifications will specifically require the contractor to comply with 40 CFR 76 and Regulation II, Control of Air Pollution from Outdoor Burning, Texas Air Control Board.

3. Texas Department of Water Resources (16 March 1978).

Comment: "The project will provide water supply needed by cities and rural areas in Collin, Dallas, Kaufman, and Rockwall Counties in the Upper Trinity River basin in North Central Texas and for cities and rural areas for counties in the Sulphur River basin in Northeast Texas.

"The North Central Texas area to be served by the Cooper Lake and Channels Project is growing rapidly. In 1974 this area had a population of 1.5 million, which is expected to increase to 2.7 million in the year 2000 and reach 5.1 million in 2030. The Northeast Texas area is also experiencing steady growth. In 1974 this area had a population of 143,700 which is expected to increase to 180 thousand in the year 2000 and reach 230 thousand in 2030.

"In the North Central Texas area municipalities and industries used 306 thousand acre-feet of fresh water during the year 1974. By the year 2000, 784 thousand acre-feet of fresh water will be needed and by 2030 this need will increase to 1.6 million acre-feet. In the Northeast Texas area municipalities and industries used 52 thousand acre-feet of fresh water during the year 1974. By the year 2000 the area will need 85 thousand acre-feet of fresh water and by 2030 this need will increase to 178 thousand acre-feet.

"The Cooper Lake and Channels Project is needed immediately to meet municipal and industrial demands for fresh water in North Central and Northeast Texas. Severe water shortages would occur in the event of a long term drought. This project will supply about 89 thousand acre-feet of water annually to the North Central Texas area in meeting the needs of that area and will enhance the water supply needs of the Northeast Texas area.

"Recognizing this need, the Texas Water Rights Commission awarded permits to North Texas Municipal Water District for 36.859 percent, the city of Irving for 36.859 percent, and to the Sulphur River Municipal Water District for 26.282 percent of the conservation storage of Cooper Lake as well as rights for diversion of their proportional share of the yield of the reservoir. The North Texas Municipal Water District provides water to cities and rural areas in North Central Texas and the Sulphur River Municipal Water District will provide water to customers in Northeast Texas.

"Since 1953, the Sulphur River basin has experienced damaging floods 10 times. Basinwide, historic damages tabulated by the Corps of Engineers total in excess of $9.3 millions. Thirty communities have been designated in the basin as having one or more potential flood-hazard areas. Completion of the Cooper Lake and Channels Project will provide significant additional flood protection for the basin. It would also allow the transfer of 120 thousand acre-feet of flood control storage in Lake Wright Patman (downstream on the Sulphur River) to Cooper Lake, thus increasing the water-supply storage in Lake Wright Patman, a source of water supply for the cities of Texarkana, Texas and Arkansas.

"The project is an essential element necessary to assist in resolving water supply problems in the Upper Trinity and Sulphur River basins and flooding problems in the Sulphur River basin and is urgently needed to meet water supply needs in the immediate future.

"The Texas Department of Water Resources, by letter dated March 10, 1978, has certified to the Corps of Engineers that the project will not result in violation of established water quality standards of the State of Texas under Public Law 92-500, Section 404 procedures.

"For these reasons, the Texas Department of Water Resources supports the issuance of a Section 404 Permit by the US Army Corps of Engineers for the Cooper Lake and Channels Project, so that construction can be initiated at the earliest possible date."

Response: Noted.

4. General Land Office (15 March 1978).

Comment: "The General Land Office staff has reviewed the Public Notice on 'Cooper Lake' and Channels, Texas, and we do not have any comments at the present."

Response: Noted.

5. State Department of Highways and Public Transportation (20 March 1978).

Comment: "The Department has no comment regarding the proposed multipurpose lake, levees, and channel improvements in the Sulphur River basin of Northeast Texas."

Response: Noted.

6. Texas Parks and Wildlife Department (21 March 1978).

Comment: "On page 3, paragraph b states that the construction of the lake will require the degrading of some existing levees within the lake area. We recommend that the Corps of Engineers consider leaving all previously constructed levees intact to serve as fish attractors in the reservoir."

Response: The plans for reservoir clearing will be reviewed with respect to current clearing criteria and the possibility of leaving the existing levees within the reservoir area intact as suggested will be considered.

Comment: "On page 8, paragraph c states that dredged material will be utilized in the construction of six channel plugs. We endorse the principal of water inflow into and through existing river segments. We therefore request that consideration be given to providing for flowage of water through the existing river segments to assure that these oxbows are not allowed to stagnate. This will also allow for the replenishment of nutrients along with a constant flow of fresh water. The resultant scouring action of constant flows would prevent sediments from being trapped and silting to occur in the channel. Current water flow patterns should be determined and duplicated for low flow periods. During periods when high flows and the threat of flooding exists, the flow could be diverted into the realined channel. By allowing for a constant flow through the existing channels, less erosion would occur in the pilot channel. This would reduce sediment loading downstream and result in less impact on fish and wildlife resources."

Response: The downstream work and disposal has now been deleted from the recommended plan.

Comment: "Portions of the project already completed have destroyed or altered 19 miles of natural stream channels. An additional 7 miles are proposed for channelization. Construction of artificial meanders as detailed in Part 3.10 Habitat Rehabilitation, Task 3: Interim Guide to the Performance of Fish and Wildlife Habitat and Population Improvement Measures for Western Dam and Reservoir Projects, WELUT Project 17, could help mitigate these alterations. A minimum of four (4) such structures per mile of previously altered channel and proposed alteration is suggested. Other structures which should be considered are check dams, wing deflectors, rock 'V' deflectors and random boulders as described in WELUT Project 17."

Response: These suggestions are mitigative proposals and, as such, have been considered in the development of the mitigation plan presented in the supplemental EIS.

Comment: "We are also concerned that there was no discussion of mitigatory procedures included in this public notice. The extent of the work proposed would indicate the need for a discussion of specific mitigation measures and their effectiveness in alleviating the impacts on fish and wildlife."

Response: Mitigation plans were not developed at the time the public notice was issued. These plans are now a part of the supplemental EIS. The TPWD has the opportunity to further comment on the draft supplement.

Comment: "Additionally, we are informed that the initial estimates of the amount of clearing and the area required for spoil deposition were low. We are informed that since projected erosion rates of the pilot channel are expected to approach 400 percent, the deposition of spoil cannot be within the 150 foot wide floodway (75 feet either side of center) and spoil deposition is planned outside the floodway. This would require the clearance of an additional 150 feet (75 feet on either side) which would enlarge the cleared bottomland hardwood to approximately 800 acres. It would be beneficial if all suitable material be utilized in the construction of levees and other appropriate structures. Unsuitable materials could then be deposited onto open or semi-wooded areas of the upland so as to protect the remaining bottomland hardwoods. The deposition of spoil onto bottomland hardwoods may adversely affect the bottomland hardwoods by increasing the ground elevation and would thus adversely affect fish and wildlife resources."

Response: The downstream channels and disposal areas have been deleted.

ATTACHMENT B

COMMENTS RECEIVED BY THE DISTRICT ENGINEER

ON THE PUBLIC NOTICE

AD-A100 100 ARMY ENGINEER DISTRICT FORT WORTH TEX F/G 13/2

COOPER LAKE AND CHANNELS, TEXAS. SUPPLEMENT.(U)

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OFFICE OF THE GOVERNOR

DOLPH BRISCOE
GOVERNOR

May 9, 1978

Colonel Thomas A. Sands
District Engineer
Department of the Army
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Sands:

Reference is made to Public Notice, Cooper Lake and Channels, Texas, published by your office in February, 1978.

A letter from this Office, dated March 23, 1978 transmitted State agency comments on the above referred public notice. Recent inquiry indicated that your office has not received this letter.

Copies of the original comments are enclosed for your information. If this Office can be of further assistance, please contact me.

Sincerely,

Roy Hogan

Roy Hogan, Assistant Director
Budget and Planning Office

Enclosures

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EXECUTIVE OFFICE BUILDING • 411 WEST 13TH STREET • AUSTIN, TEXAS 78701

Texas Department of Health

Fratis L. Duff, M.D., Dr.P.H.
Commissioner

Raymond T. Moore, M.D.
Deputy Commissioner

1100 West 49th Street
Austin, Texas 78756
458-7111

RECEIVED
MAR 27 1978
Bud. & Planning

March 23, 1978

Mr. Ward C. Goessling, Jr., Coordinator
Natural Resources Section
Governor's Budget and Planning Office
Executive Office Building
411 West 13th Street
Austin, Texas 78701

SUBJECT: Cooper Lake and Channels, Texas
Sulphur River Basin
Delta and Hopkins Counties
U.S. Army Corps of Engineers
Draft Supplement to Final EIS

Dear Mr. Goessling:

The Draft Supplement to the Final Environmental Impact Statement for the Cooper Lake and Channels Project has been reviewed for its public and environmental health implications. The Public Notice regarding the project dated 24 February 1978, was issued by the Department of the Army, New Orleans District, Corps of Engineers. The procedures initiated in this Notice are a part of the "Section 404" procedures of the Federal Water Pollution Control Act. The Final Environmental Impact Statement was issued in April, 1977.

The Notice of the Draft Supplement to the Final Environmental Impact Statement proposes the construction of a multipurpose lake, levees, and channel improvements in the Sulphur River Basin of Northeast Texas to provide flood control, water supply, and recreation over a useful life of 100 years. Clearing of approximately 15,900 acres of land which will be inundated will be required; also the relocation of minor utilities and the Friendship and Liberty Grove Cemeteries. Recreational facilities including potable water supplies, picnic areas, and comfort stations will be developed.

Mr. Goessling
Page Two
March 23, 1978

Based on information contained in the Public Notice no adverse public or environmental health conditions are expected to result from the proposed construction. Relocation of public water supply and wastewater facilities may require plan and specification approval by the Texas Department of Health. If storm sewer and drainage facilities are properly designed, constructed, and maintained, it is expected that habitats for mosquito breeding will be minimal.

We appreciate the opportunity to review and comment on the Public Notice of a Draft Supplement to the Environmental Impact Statement for Cooper Lake and Channels.

Sincerely,

G. R. Herzik, Jr., P.E.
Deputy Commissioner for Environmental
and Consumer Health Protection

DLH/cdd

ccs: Public Health Region 7, TDH
Division of General Sanitation, TDH
Division of Water Hygiene, TDH

TEXAS AIR CONTROL BOARD

8520 SHOAL CREEK BOULEVARD
AUSTIN, TEXAS 78758
512/451-5711

March 23, 1978

Mr. Ward C. Goessling, Jr.
Natural Resources Section
Budget and Planning Office
Office of the Governor
411 West 13th Street
Austin, Texas 78701

Subject: Public Notice: Cooper Lake and Channels, Texas

Dear Mr. Goessling:

We have reviewed the above cited document and have no further comments to add to those of our initial response to the Draft Environmental Statement of June 23, 1976 relative to this project. We do reiterate that any outdoor burning should be done in accordance with the Rules and Regulations of the Texas Air Control Board.

Thank you for the review opportunity. If we can assist further, please contact me.

Sincerely,

Roger R. Wallis

Roger R. Wallis, Deputy Director
Standards and Regulations Program

cc: Mr. Richard Leard, Regional Supervisor, Tyler

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

RECEIVED
APR 2
Budget

TEXAS WATER DEVELOPMENT BOARD
A. L. Black, Chairman
Robert B. Gilmore
Milton T. Potts
John H. Garrett
George W. McCleskey
Glen E. Roney

RECEIVED
MAR 21 1978
Central Records
Texas Dept. of Water Resources

Harvey Davis
Executive Director

TEXAS WATER COMMISSION
Joe D. Carter, Chairman
Dorsey B. Hardeman
Joe R. Carroll

March 16, 1978

PP-USCE-FC
(Cooper Res)

Mr. Charles D. Travis, Director
Governor's Budget and Planning Office
Executive Office Building
411 West 13th Street
Austin, Texas 78701

Stearman JA
Grubb
Burnitt
Nemir CEN
Davis HD

Dear Mr. Travis:

Re: Public Notice: Cooper Lake and Channels, Texas

In reference to your correspondence of February 28, 1978 regarding the Public Notice: Cooper Lake and Channels, Texas, our agency has reviewed the subject document and offers the following comments.

The project consists of a multipurpose lake, levees, and channel improvements in the Sulphur River Basin of Northeast Texas to provide flood control, water supply, and recreation over a useful life of 100 years.

The project will provide water supply needed by cities and rural areas in Collin, Dallas, Kaufman, and Rockwall Counties in the Upper Trinity River Basin in North Central Texas and for cities and rural areas for counties in the Sulphur River Basin in Northeast Texas.

The North Central Texas area to be served by the Cooper Lake and Channels project is growing rapidly. In 1974 this area had a population of 1.5 million, which is expected to increase to 2.7 million in the year 2000 and reach 5.1 million in 2030. The Northeast Texas area is also experiencing steady growth. In 1974 this area had a population of 143,700, which is expected to increase to 180 thousand in the year 2000 and reach 230 thousand in 2030.

In the North Central Texas area municipalities and industries used 306 thousand acre-feet of fresh water during the year 1974. By the year 2000, 784 thousand acre-feet of fresh water will be needed and by 2030 this need will increase to 1.6 million acre-feet. In the Northeast Texas area municipalities and industries used 52 thousand acre-feet of fresh water during the year 1974. By the year 2000 the area will need 85 thousand acre-feet of fresh water and by 2030 this need will increase to 178 thousand acre-feet.

P.O. Box 13087 Capitol Station • Austin, Texas 78711 • Area Code 512/475-3187

Mr. Charles D. Travis
March 16, 1978
Page 2

The Cooper Lake and Channels project is needed immediately to meet municipal and industrial demands for fresh water in North Central and Northeast Texas. Severe water shortages would occur in the event of a long term drought. This project will supply about 89 thousand acre-feet of water annually to the North Central Texas area in meeting the needs of that area and will enhance the water supply needs of the Northeast Texas area.

Recognizing this need the Texas Water Rights Commission awarded permits to North Texas Municipal Water District for 36.859 percent, the City of Irving for 36.859 percent and to the Sulphur River Municipal Water District for 26.282 percent of the conservation storage of Cooper Lake as well as rights for diversion of their proportional share of the yield of the reservoir. The North Texas Municipal Water District provides water to cities and rural areas in North Central Texas and the Sulphur River Municipal Water District will provide water to customers in Northeast Texas.

Since 1953, the Sulphur River Basin has experienced damaging floods 10 times. Basinwide, historic damages tabulated by the Corps of Engineers total in excess of $9.3 million. Thirty communities have been designated in the basin as having one or more potential flood-hazard areas. Completion of the Cooper Lake and Channels project will provide significant additional flood protection for the basin. It would also allow the transfer of 120 thousand acre-feet of flood control storage in Lake Wright Patman (downstream on the Sulphur River) to Cooper Lake, thus increasing the water-supply storage in Lake Wright Patman, a source of water supply for the cities of Texarkana, Texas and Arkansas.

The project is an essential element necessary to assist in resolving water supply problems in the Upper Trinity and Sulphur River Basins and flooding problems in the Sulphur River Basin and is urgently needed to meet water supply needs in the immediate future.

The Texas Department of Water Resources, by letter dated March 10, 1978, has certified to the Corps of Engineers that the project will not result in violation of established water quality standards of the State of Texas under Public Law 92-500 Section 404 procedures.

For these reasons, the Texas Department of Water Resources supports the issuance of a Section 404 Permit by the U.S. Army Corps of Engineers for the Cooper Lake and Channels project, so that construction can be initiated at the earliest possible date.

Sincerely,

Harvey Davis
Executive Director

HD/nh

General Land Office
AUSTIN, TEXAS 78701
BOB ARMSTRONG, COMMISSIONER

PLANNING PROGRAM
1700 North Congress Ave.
Austin, Texas 78711

(512) 475-1539

RECEIVED
APR 27 1978
Budget/Planning

March 15, 1978

Mr. Albert Schutz
Budget and Planning Office
Office of the Governor
411 West 13th Street
Austin, Texas 78711

RE: Public Notice: Cooper Lake and Channels, Texas

Dear Mr. Schutz:

The General Land Office staff has reviewed the Public Notice on "Cooper Lake"and Channels, Texas and we do not have any comments at the present.

We appreciate the opportunity to submitt our comments.

Sincerely,

A.J. Bishop,
Coordinator

AJB:mr

COMMISSION

REAGAN HOUSTON, CHAIRMAN
DEWITT C. GREER
CHARLES E. SIMONS

STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION
AUSTIN, TEXAS 78701

ENGINEER-DIRECTOR
B. L. DEBERRY

March 20, 1978

IN REPLY REFER TO
FILE NO.

D 8-R 454

Public Notice
U.S. Army Corps of Engineers
Cooper Lake and Channels

RECEIVED
APR 27 1978
Budget/Planning

Mr. Ward C. Goessling, Jr., Coordinator
Natural Resources Section
Governor's Budget and Planning Office
411 West 13th Street
Austin, Texas 78701

Dear Sir:

Reference is made to your memorandum dated February 28, 1978 transmitting the above captioned public notice for review and comments.

The Department has no comment regarding the proposed multipurpose lake, levees, and channel improvements in the Sulphur River Basin of Northeast Texas.

Sincerely yours,

B.L. DeBerry
Engineer-Director

By: Original Signed
For R. L. LEWIS

R.L. Lewis, Chief Engineer
of Highway Design

MHK/ed

bcc: FHWA
D-5
RLL
JWB

Appendix E

TEXAS
PARKS AND WILDLIFE DEPARTMENT

4200 Smith School Road
Austin, Texas 78744

MAR 21 1978

Mr. Ward C. Goessling, Jr., Coordinator
Natural Resources Section
Governor's Budget and Planning Office
Executive Office Building
411 West 13th Street
Austin, Texas 78701

COPY

Re: Public Notice - Cooper Lake and Channels, Texas

Dear Mr. Goessling:

This agency has reviewed the referenced notice and offers the following comments.

On page 3, paragraph b. states that the construction of the lake will require the degrading of some existing levees within the lake area. We recommend that the Corps of Engineers consider leaving all previously constructed levees intact to serve as fish attractors in the reservoir.

On page 8, paragraph c. states that dredged material will be utilized in the construction of six channel plugs. We endorse the principal of water inflow into and through existing river segments. We therefore request that consideration be given to providing for flowage of water through the existing river segments to assure that these oxbows are not allowed to stagnate. This will also allow for the replenishment of nutrients along with a constant flow of fresh water. The resultant scouring action of constant flows would prevent sediments from being trapped and silting to occur in the channel. Current water flow patterns should be determined and duplicated for low flow periods. During periods when high flows and the threat of flooding exists, the flow could be diverted into the realigned channel. By allowing for a constant flow through the existing channels, less erosion would occur in the pilot channel. This would reduce sediment loading downstream and result in less impact on fish and wildlife resources.

MAR 21 1978

Mr. Ward C. Goessling, Jr.
Page Two

MAR 2 1 1978

Portions of the project already completed have destroyed or altered 19 miles of natural stream channels. An additional 7 miles are proposed for channelization. Construction of artificial meanders as detailed in Part 3.10 Habitat Rehabilitation, Task 3: Interim Guide to the Performance of Fish and Wildlife Habitat and Population Improvement Measures for Western Dam and Reservoir Projects, WELUT Project 17, could help mitigate these alterations. A minimum of four (4) such structures per mile of previously altered channel and proposed alteration is suggested. Other structures which should be considered are check dams, wing deflectors, rock "V" deflectors and random boulders as described in WELUT Project 17.

We are also concerned that there was no discussion of mitigatory procedures included in this public notice. The extent of the work proposed would indicate the need for a discussion of specific mitigation measures and their effectiveness in alleviating the impacts on fish and wildlife.

Additionally, we are informed that the initial estimates of the amount of clearing and the area required for spoil deposition were low. We are informed that since projected erosion rates of the pilot channel are expected to approach 400 percent, the deposition of spoil cannot be within the 150 foot wide floodway (75 feet either side of center) and spoil deposition is planned outside the floodway. This would require the clearance of an additional 150 feet (75 feet on either side) which would enlarge the cleared bottomland hardwood to approximately 800 acres. It would be beneficial if all suitable material be utilized in the construction of levees and other appropriate structures. Unsuitable materials could then be deposited onto open or semi-wooded areas of the upland so as to protect the remaining bottomland hardwoods. The deposition of spoil onto bottomland hardwoods may adversely affect the bottomland hardwoods by increasing the ground elevation and would thus adversely affect fish and wildlife resources.

Thank you for the opportunity to review and comment on the public notice. If we can be of further assistance, please contact us.

Sincerely,

HENRY B. BURKETT
Executive Director

HBB:NM:bp

cc: Mr. David Soileau
U. S. Fish and Wildlife Service
Lafayette, Louisiana

MAR 2 1 1978

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

IN REPLY REFER TO
LMNED-MP

22 May 1978

Mr. Roy Hogan, Assistant Director
Budget and Planning Office
Office of the Governor of Texas
411 West 13th Street
Austin, Texas 78701

Dear Mr. Hogan:

This is to acknowledge your letter of 9 May 1978 concerning our 24 February 1978 public notice on the Cooper Lake and Channels, Texas, project.

The period of comment on the public notice ended 27 March 1978; however, since your letter of 23 March 1978 was not received by my office, your letter of 9 May 1978 forwarding the comments of six state agencies will be incorporated into the official record. I have received no request for a public hearing on the disposal plan and I have, therefore, determined that a public hearing on this matter is not required. We are presently preparing the statement of findings addressing the comments we have received and I intend to complete and submit the statement of findings to EPA shortly following the ruling of the Court, depending, of course, on the nature of the Court's decision.

If you require any further information, please contact me.

Sincerely yours,

Early J Rush III

EARLY J. RUSH III
Colonel, CE
District Engineer

Copy furnished with basic letter:
Mr. Houston Abel
Assistant U.S. Attorney
P.O. Box 1049
Tyler, Texas 75710

Lone Star Gas Company
301 S. Harwood Street • Dallas, Texas 75201

RIGHT OF WAY AND CLAIMS DEPARTMENT
PURVY L. STONE, Director

March 6, 1978

Mr. Early J. Rush III
Department of the Army
New Orleans District, Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Re: Public Notice
Cooper Lake & Channels, Texas

Dear Mr. Rush:

Your public notice on Cooper Lake and Channels, Texas has been received. We cannot determine by the small maps or sketches showing the dams, reservoirs and levees which of our pipelines will be affected by the proposed project; therefore, will you please furnish us with larger prints of all your proposed levees, channels, dams and the area upon which water will be impounded to enable us to further consider the location of our pipelines in relation to the project. We will then be in a position to give further thought to this matter and not delay the project if it is approved by all governmental bodies.

This letter is not intended to be used as a notice or demand for a public hearing. Lone Star Gas Company has no objections to the project provided it is reimbursed for all charges and expenses incurred in adjusting or relocating company facilities to conform to the project.

Yours very truly,

Purvy L. Stone

Purvy L. Stone

PLS:do

cc: Mr. L. A. Blakely

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT. CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

IN REPLY REFER TO
LMNED-MP

22 March 1978

Mr. Purvy L. Stone, Director
Right of Way and Claims Department
Lone Star Gas Company
301 S. Harwood Street
Dallas, Texas 75201

Dear Mr. Stone:

This is in response to your 6 March 1978 letter on Cooper Lake and Channels, Texas - Section 404 Public Notice. I am pleased to inclose four large prints showing Cooper Lake and the proposed levees and channels as requested. If I can be of any further assistance, please contact me.

Sincerely yours,

William B. Seale
FREDERIC M. CHATRY
Chief, Engineering Division

4 Incl
1. Plate 7.1-File No. H-2-26659
2.. Plate 7.2-File No. H-2-26659
3. Plate 7.3-File No. H-2-26659
4. Plate 3.4-File Nc. H-2-26659

ANDREW H. HULSEY, Director

COMMISSIONERS
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DR. P. M. JOHNSTON
FAYETTEVILLE

Arkansas
Game and Fish Commission

LITTLE ROCK, ARKANSAS 72201

March 13, 1978

Col. Early J. Rush, III
District Engineer, New Orleans District
U. S. Army Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Col. Rush:

Receipt is acknowledged of your Public Notice of February 28, 1978 concerning Corps of Engineers' procedures to dispose of dredged or fill material under the auspices of Section 404 of the Federal Water Pollution Control Act in connection with the Cooper Lake and Channels, Texas Project.

The ramifications of proposed actions in this regard are largely of an interstate nature and accordingly, we shall defer primary review and comment prerogatives to the U. S. Fish and Wildlife Service. Your office should be advised that the Arkansas Game and Fish Commission owns and operates a 16,000-acre Wildlife Management Area along the Arkansas portion of the Sulphur River and, more particularly, that wetlands within the boundaries of the Sulphur River Wildlife Management Area are considered to be critical habitat for the American Alligator - a Federally-listed Endangered Species in Arkansas. By copy of this letter, we are advising the U. S. Fish and Wildlife Service of our desire to cooperate as requested in the evaluation of your proposed activities.

Very truly yours,

Andrew H. Hulsey
Director

AHH:RWB:ac

cc: U. S. Fish & Wildlife Service
Field Office, Vicksburg
Area Office, Jackson

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

IN REPLY REFER TO
LMNED-MP

10 April 1978

Mr. Andrew H. Hulsey, Director
Arkansas Game and Fish Commission
Little Rock, Arkansas 72201

Dear Mr. Hulsey:

This is to acknowledge your letter of 13 March 1978 concerning our 24 February 1978 public notice on the Cooper Lake and Channels, Texas, project.

The period of comment on the public notice ended 27 March 1978 and I have received no request for a public hearing on the disposal plan. I have, therefore, determined that a public hearing on this matter is not required and I intend to proceed with the preparation of the statement of findings addressing the comments we have received, and to complete and submit the statement of findings to EPA shortly following the ruling of the Court, depending, of course, on the nature of the Court's decision.

Thank you for your timely attention to this matter.

Sincerely yours,

Early J. Rush

EARLY J. RUSH III
Colonel, CE
District Engineer

Copy furnished with basic ltr:
Mr. Houston Abel
Assistant U.S. Attorney
P.O. Box 1049
Tyler, Texas 75710

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

TEXAS WATER DEVELOPMENT BOARD
A. L. Black, Chairman
Robert B. Gilmore, Vice Chairman
Milton T. Potts
John H. Garrett
George W. McCleskey
Glen E. Roney

Harvey D. Davis
Executive Director

TEXAS WATER COMMISSION
Joe D. Carter, Chairman
Dorsey B. Hardeman
Joe R. Carroll

March 10, 1978

Colonel Early J. Rush III
District Engineer
Department of the Army
New Orleans District
Corps of Engineers
P. O. Box 60267
New Orleans, Louisiana 70160

Dear Colonel Rush:

Re: Request for Certification
LMNED-MP
Cooper Lake and Channels, Texas

This is in response to your public notice dated February 24, 1978 requesting comments on the proposed disposal of dredged or fill material into the waters of the United States pursuant to Section 404 of the Federal Water Pollution Control Act that the construction of Cooper Lake and channels, Cooper Dam including excavation and fill and accompanying levees, will not cause violation of established Texas Water Quality Standards.

We believe there is reasonable assurance, subject to the qualifications and requirements checked on the attached pages, that the activity you have proposed will be conducted in a manner that will not violate applicable water quality standards. In making this certification, we limit it to those things under the jurisdiction of this agency according to the various statutes which this agency administers.

No review of property rights has been made nor has any review been made as to the location of property lines, and especially, no review has been made as to the distinction between public and private ownership, and this certification may not be used in any way with regard to questions of ownership.

We appreciate your cooperation in this matter, and if we can be of additional assistance, please let us know.

P.O. Box 13087 Capitol Station • Austin, Texas 78711 • Area Code 512/475-3187

Colonel Early J. Rush III
District Engineer
Department of the Army
New Orleans District
Corps of Engineers
Page 2 of 2
March 10, 1978

Sincerely yours,

J. C. Newell

by J. C. Newell, P.E.
Director, Wastewater Section
Permits Division

Harvey Davis
Executive Director

Attachment
ccs: Texas Department of Water Resources District 5 - Kilgore
Texas Parks and Wildlife Department
United States Environmental Protection Agency
General Land Office
United States Fish and Wildlife Service, Austin

Attachment 1
Request for Certification
LMNED-MP
Coopers Lake
March 10, 1978

- [X] 1. The work must be done with the minimum production of turbidity in the waters where the work is taking place.

- [X] 2. Spoil must be placed in spoil areas approved by the United States Army Corps of Engineers and Texas Parks & Wildlife Department in such a manner as to minimize the runoff of spoil or highly turbid waters into adjacent waters.

- [X] 3. The discharge of oil, gasoline, or other fuel or materials capable of causing pollution arising from your operations is prohibited.

- [ ] 4. Natural shoreline configurations shall be restored as much as possible to their former state.

- [ ] 5. Pipelines are to be inspected periodically for leakage. Should leaks be discovered, pumping must stop until leaks are repaired.

- [ ] 6. Provision must be made for containment of any spillage which would occur during loading or unloading operations, and for prevention of the discharge or leakage of chemical products or other contaminants into State waters.

- [X] 7. Sanitary wastes are to be retained for disposal onshore in some legal manner.

- [ ] 8. The arrangement of the constructed dock and its appartenance shall be such that shoreside waste receiving and treating facilities can be added to serve boat customers for both sanitary wastes and other wastes as may in the future be required. Provision of these facilities is not by this letter required, but arrangements and/or space shall be such that they can be added conveniently.

- [ ] 9. Notify the Texas Department of Water Resources district office in prior to commencement of the project.

- [ ] 10. It should be noted that this portion of is environmentally sensitive, therefore, precautions for minimizing any degradation of water quality are recommended.

- [ ] 11. Liquid decanted from the spoil disposal area shall be returned to the channel being dredged.

- [ ] 12. The name of the person in charge of the operation of the dredge shall be supplied to the Texas Department of Water Resources district office in prior to initiation of the project.

- [ ] 13. Future draining of the spoil disposal area shall comply with all provisions applied to the initial project operations.

(OVER)

TDWR-0061

Attachment 1 (Continued)
Request for Certification

☐ 14. Signs shall be posted on either side of the waterway including ownership and emergency telephone numbers.

☐ 15. Should development of this lease require dredging at some future date, the Company must apply to this agency for further certification.

☐ 16. This project is being recertified according to the provisions indicated. This certification expires at the end of the period covered by the applicable United States Army Corps of Engineers permit.

☐ 17. Materials resulting from the destruction of the existing structure must be removed from the water and disposed of in some legal manner.

☐ 18. Fill must be placed behind the bulkhead in such a manner as to minimize the runoff of turbid water to

☐ 19. The dredged material shall be placed in an adequately leveed disposal area with controlled spillways.

☒ 20. During construction, adequate erosion control methods shall be used in order to minimize runoff and consequent elevations of turbidity in Coopers Lake.

☒ 21. Areas devegetated during construction shall be replanted to the extent practicable after project completion, to avoid excessive erosion and the runoff of turbid waters to waters of the State.

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

IN REPLY REFER TO
LMNED-MP

10 April 1978

Mr. J. C. Newell, Director
Wastewater Section, Permits Division
Texas Department of Water Resources
1700 N. Congress Avenue
Austin, Texas 78701

Dear Mr. Newell:

This is to acknowledge your letter of 10 March 1978 concerning our 24 February 1978 public notice on the Cooper Lake and Channels, Texas, project. I interpret the certification provided by your letter to cover Sections 61 and 67 of the Clean Water Act of 1977 (Public Law 95-217) enacted on 27 December 1977, in addition to any other programs which your agency administers.

The period of comment on the public notice ended 27 March 1978 and I have received no request for a public hearing on the disposal plan. I have, therefore, determined that a public hearing on this matter is not required and I intend to proceed with the preparation of the statement of findings addressing the comments we have received, and to complete and submit the statement of findings to EPA shortly following the ruling of the Court, depending, of course, on the nature of the Court's decision.

Thank you for your timely attention to this matter.

Sincerely yours,

EARLY J. RUSH III
Colonel, CE
District Engineer

Copy furnished with basic ltr:
Mr. Houston Abel
Assistant U.S. Attorney
P.O. Box 1049
Tyler, Texas 75710

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Box 4-4753, USL
Lafayette, Louisiana
70504

March 20, 1978

District Engineer
U.S. Army Corps of Engineers
P.O. Box 60267
New Orleans, Louisiana 70160

Dear Sir:

Reference is made to public notice LMNOD-MP(Cooper Lake and Channels, Texas), dated February 24, 1978. The notice was issued in accordance with provisions of Federal Regulations, Title 33 CFR 209.145, as mofidifed in part by EC 1130-2-157, dated October 1, 1977. The New Orleans Corps District proposes to place fill material and excavate and dispose of spoil on approximately 632 acres of seasonally flooded bottomland hardwoods in conjunction with the construction of a dam and downstream levees and channels along the South Sulphur and Sulphur Rivers in Northeast Texas. Our comments are submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

In a letter report dated September 3, 1976, the Fish and Wildlife Service recommended several mitigative measures for incorporation into the project, including installation of water control structures at the juncture of manmade and natural stream channels to divert normal streamflows through natural stream segments, increased low-flow releases from the reservoir, and establishment of an interagency study team to locate areas suitable for acquisition and management in compensation for project-induced wildlife losses. The plans outlined in the public notice do not incorporate any of these recommendations.

A meeting held on November 3, 1977, between personnel of our respective agencies resulted in an agreement to initiate a coordinated interagency effort for the purpose of preparing a mitigation report to be submitted for congressional authorization. We have subsequently been informed that the Memphis Corps District is in the process of examining the Ecological Planning and Evaluation Procedures' data used in the preparation of our September 3, 1976, report to determine the need for additional field studies. We

have not yet been informed by Memphis District personnel whether these data are adequate for use in the preparation of the mitigation report.

Our report of September 3, 1976, has adequately outlined our major areas of concern. Since a decision on the adequacy of the final EIS for this project is still pending in the U.S. District Court for the Eastern District of Texas, we believe that comments on your proposed disposal plans would be premature at this time. We strongly urge renewed interagency cooperation with the ultimate goal of establishing a plan for compensation of the adverse affects of the direct and indirect impacts to fish and wildlife resources associated with project implementation. Accordingly, we recommend that any decision on disposal of dredged or fill material be held in abeyance until a complete mitigation report has been submitted for congressional approval.

Sincerely yours,

Cary W. Kerlin

Cary W. Kerlin
Field Supervisor

cc: EPA, Dallas, Texas
Texas Parks and Wildlife Department, Austin, Texas
Area Office, Jackson, Miss.

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

IN REPLY REFER TO
LMNED-MP

10 April 1978

Mr. Cary W. Kerlin
Field Supervisor
U.S. Fish and Wildlife Service
Box 44753, USL
Lafayette, Louisiana 70504

Dear Mr. Kerlin:

This is to acknowledge your letter of 20 March 1978 concerning our 24 February 1978 public notice on the Cooper Lake and Channels, Texas, project. This notice was issued in accordance with the provisions of Federal Regulations, Title 33 CFR 209.145, as modified in part by EC 1130-2-157 dated 1 October 1977. I understand that your letter was submitted under the specific provisions of 33 CFR 209.145 and under the general provisions of the Fish and Wildlife Coordination Act; however, you indicate that you feel it premature to comment on the disposal plan at this time in view of the as yet unsettled litigation before the U.S. District Court for the Eastern District of Texas.

The period of comment on the public notice ended 27 March 1978 and I have received no request for a public hearing on the disposal plan. I have, therefore, determined that a public hearing on this matter is not required and I intend to proceed with the preparation of the statement of findings addressing the comments we have received and to complete and submit the statement of findings to EPA shortly following the ruling of the Court, depending, of course, on the nature of the Court's decision. I do not know when the Court will rule on this case; however, I expect a decision in the near future. I therefore urge you to furnish us any additional comment you deem appropriate as soon as possible.

The Memphis District of the U.S. Army Corps of Engineers has been assigned the responsibility of preparing the mitigation report under our guidance. I understand that the Memphis District personnel have been reviewing your Ecological Planning and Evaluation Procedures data, as

LMNED-MP 10 April 1978
Mr. Cary W. Kerlin

you indicated, while awaiting better field conditions for an orientation site visit. They have recently toured the project area and should be in contact with you to arrange for a joint field study in the near future.

Sincerely yours,

EARLY J. RUSH III
Colonel, CE
District Engineer

Copy furnished with basic ltr:
Mr. Houston Abel
Assistant U.S. Attorney
P.O. Box 1049
Tyler, Texas 75710

ATTACHMENT C

PUBLIC NOTICE

(Plates 6-18 of the Public
Notice Related to Levee
and Channel Work
Have Been Deleted)

DEPARTMENT OF THE ARMY
NEW ORLEANS DISTRICT, CORPS OF ENGINEERS
P. O. BOX 60267
NEW ORLEANS, LOUISIANA 70160

IN REPLY REFER TO
LMNED-MP

24 February 1978

PUBLIC NOTICE

COOPER LAKE & CHANNELS, TEXAS

This public notice is issued in accordance with provisions of Federal Regulations, Title 33 CFR 209.145, as modified in part by EC 1130-2-157 dated 1 October 1977, pursuant to Section 404 of the Federal Water Pollution Control Act, concerning the policy, practice, and procedures to be followed by the US Army Corps of Engineers in connection with disposal of dredged or fill material in the waters of the United States or the transportation of dredged material for the purpose of dumping it in ocean water associated with Federal projects. The procedures initiated by this notice are commonly known as the Section 404 procedures in reference to Section 404 of the Federal Water Pollution Control Act.

This notice is being distributed to all interested state and Federal agencies and known interested persons in order to assist in developing facts and recommendations concerning the initial construction of project features.

PROJECT: Cooper Lake and Channels, Texas.

PROJECT AUTHORITY: Congressional authorization for the construction of the Cooper Lake and Channels, Texas, project is contained in the Flood Control Act approved 3 August 1955 (Public Law 218, Chapter 501, 84th Congress, 1st Session). The Act authorizes the construction of Cooper Lake and channel and levee improvement ". . . substantially in accordance with the construction plans recommended in the report of the Chief of Engineers in House Document Numbered 488, Eighty-third Congress, 2nd Session . . ."

STATUS OF LITIGATION: Construction of the project began in 1958 and continued into 1971. In June 1971 the US District Court for the Eastern District of Texas, in civil action no. 549 acting on a motion for preliminary injunction by the Texas Committee on Natural Resources, et al., enjoined further construction on the project until an environmental impact statement (EIS), as required by the National Environmental Policy Act, was filed with the President's Council on Environmental Quality (CEQ). The Court, however, permitted planning, real estate acquisition, and other nonconstruction

activities associated with the project to proceed. The final EIS was filed with CEQ on 24 June 1977 and the trial on its adequacy was held in the US District Court for the Eastern District of Texas on 9 through 17 January 1978. A decision on the case is expected around April 1978.

No construction or relocation work on the project can be initiated unless a favorable ruling on the case is obtained from the Court. Furthermore, no construction can begin on Cooper Dam or the downstream levee and channel improvements until the procedures initiated by this notice are completed. However, if a favorable Court decision is obtained, certain other work, namely the South Access Road, the relocation of Tucker Cemetery, the Lone Star Gas pipeline relocation and the initial Texas Power and Light utility relocation, can begin prior to completion of the Section 404 procedures since these procedures, unlike the Court's injunction, do not apply to that work.

This notice is being issued and the Section 404 procedures are being initiated in advance of a ruling on the case from the Court as part of the environmental planning on the project which the Court, under the terms of its injunction, has allowed to continue. However, the procedures will not be carried further than the publication of this notice and receipt of comments unless a favorable ruling is obtained from the Court. Should the Court's ruling be unfavorable, the Section 404 process would be interrupted and reevaluated in light of the ruling.

PROJECT DESCRIPTION: The project consists of a multipurpose lake, levees, and channel improvements in the Sulphur River Basin of Northeast Texas to provide flood control, water supply, and recreation over a useful life of 100 years. (See plate 1.)

a. Cooper Dam. The earthfill dam and spillway works will be located at mile 23.2 of the South Sulphur River near Cooper, Texas. The lake will contain storage space for flood control (131,400 acre-feet), municipal and industrial water supply (273,000 acre-feet), and a reserve for sedimentation (37,000 acre-feet). The 131,400 acre-foot flood control storage space will reduce flood flows below the dam and will permit a possible future conversion of 120,000 acre-feet of existing storage space in Wright Patman Lake from flood control to water supply. The decision whether or not to implement this storage space conversion, however, will be a future determination to be made in accordance with the provisions of the Nationa Environmental Policy Act of 1969. The following facilities will be associated with the construction of Cooper Dam. (See plate 2.)

(1) An earthen dam embankment 15,882 feet long with a hard surface public use road crossing the dam for a majority of its length on a berm adjacent to the downstream toe of the dam. The dam will average 40 feet in height with a maximum height of 73 feet.

(2) A concrete spillway 266 feet long with accompanying inlet and outlet channels as shown. A concrete bridge will span the service spillway and will be a part of the public use road. The service spillway will be used for both the normal operational releases and the design flood releases from the lake.

(3) An earthen emergency spillway 4,200 feet long with the hard surface public use road traversing the spillway crest.

(4) A tailwater fishery parking area adjacent to the service spillway outlet channel and an administration complex at the north dam abutment consisting of a visitor's center and maintenance area, an overlook building, and a boat launch and parking area.

(5) Minor utility relocations, the relocation of Tucker Cemetery out of the dam site, and the raising of a portion of Dawson Cemetery.

(6) An access road, approximately 1.1 miles in length, from the south dam abutment to State Highways 19 and 154 west of Tira, Texas. (See plate 3.) This new road will be used for construction access and then repaired and incorporated into the state highway system along with the public use road across the dam.

(7) An access road (Farm-to-Market Road 1529) approximately 1.8 miles in length, from the north dam abutment to its junction with State Highway 154 east of Cooper, Texas. (See plate 3.) This existing road will be used for construction access and then upgraded and incorporated into the state highway system along with the public use road across the dam.

b. Cooper Lake Development. (See plate 4.) Development of the lake will require the clearing of approximately 15,900 acres of land within the lake area which will be inundated including approximately 700 acres of land which will be cleared and graded for fish seining areas. Minor utilities relocations within the lake area will be required. Two cemeteries, Friendship and Liberty Grove, will be relocated out of the lake area. Thirty-three hundred acres of land at seven sites will be available for recreational development. Adequate roads and parking facilities will be developed for visitors. Other facilities which include boat launching ramps, trails, picnicking and camping areas, potable water supplies, comfort stations, shelters, beaches, and safety features will be provided based on the number of annual visitors. Facilities will be so located as to utilize and enhance the natural beauty of all sites. Landscaping will be accomplished to complement the surrounding natural beauty and to establish vegetative growth over the construction areas. The construction of Cooper Lake will require the relocation or alteration of 1.1 miles of Farm-to-Market Road 1528 (including two bridges as shown on plate 5) and the construction of a 0.8-mile section of Harper's Crossing Connecting Road (near Doctors Creek Recreation Area). Cooper Lake construction will also require the degrading of some existing levees within the lake area.

c. Levees and Channels Upstream of the Lake. The project provides for the improvement of 7.4 miles of agricultural levees and the excavation

of 18.4 miles of realined river channel together with the clearing of a floodway along the realined channel on the South Sulphur and Middle Sulphur Rivers. This work was begun in 1958 and completed in 1959.

d. Levees and Channels Downstream from the Lake. (See plate 1.) The project provides for the enlargement, extension and construction of 66.8 miles of levees and the excavation of 25.4 miles of realined channel together with the clearing of a floodway along the realined channel on the Sulphur, South Sulphur, and North Sulphur Rivers, and on Cuthand and Brushy Creeks. Of this, approximately 40 miles of levee work and 19 miles of channel work have been completed. The remaining channel work (approximately 7 miles) is an 80 percent reduction in the channel work required under the previously authorized project plan. This change in the project plan is described in the final environmental statement dated April 1977.

(1) Completed Work. Construction of the levee and channel improvements downstream of Cooper Lake commenced in September 1959 and continued intermittently as rights-of-way and funds became available until April 1964. During this time, the following work was accomplished:

(a) Cuthand Creek - 15.1 miles of channelization and 13.9 miles of levee work (levees 4LC and 5LC).

(b) Sulphur River - 11.9 miles of levee work (levees 1LS and 1RS).

(c) Brushy Creek - 0.8 mile of channelization.

(d) North Sulphur River - 9.6 miles of levee work (levee 1RN).

(e) South Sulphur River - 4.5 miles of levee work (levee 5RSS).

Project modifications and spending limitations prevented construction of levees and channels between April 1964 and February 1971 at which time a contract was awarded for levee and channel work downstream from US Hwy 271. In June 1971, further construction on the project was enjoined as discussed earlier. The levee and channel contract in progress was, therefore, terminated. Before the preliminary injunction was ordered, 8.7 miles of floodway clearing and 3.0 miles of channelization within the cleared floodway had been accomplished.

(2) Remaining levee work. The remaining levee work (approximately 26.9 miles) will include enlargement, extension, or construction of new levees. The length and volume of fill required for the remaining levee work are shown in the following tabulation:

Levee 2/	Stream	Length (ft)	(mi)	Volume (C.Y.)
(Ext) 4RSS (Spur)	South Sulphur	5,000	0.9	25,000
(Ext) 4LSS	South Sulphur	25,100	4.7	255,000
(Ext) 3RS (Spur)	Sulphur	4,284	0.8	
(Ext) 3RS	Sulphur	22,000	4.2	2,850,000 1/
(E) 3RS	Sulphur	34,544	6.5	
(N) 4RS	Sulphur	51,600	9.8	2,195,000
		142,528 ft.	26.9 mi	5,325,000 C.Y.

E - Levee enlargement
Ext - Levee extension
N - New levee
1/ - Total 3RS

Bank of River (Right or Left Bank Designation Looking Downstream)

2/ Levee Designation 4 R SS

Consecutive Levee Numbering Increasing Downstream

River to which levee is adjacent (can be S or SS for Sulphur River, or South Sulphur River)

Since the present levee 4RSS will be cut by the service spillway outlet channel, an extension spur levee [4RSS (Spur)] approximately 5,000 feet long will be alined parallel to and east of the spillway outlet channel (see plate 2). Levee 4LSS, 3RS, and 4RS were designed as open end levees and interior runoff will be discharged into the river channels through natural drainage channels and landside drainage ditches. However, a single 48-inch corrugated metal pipe culvert with an automatic flap gate is proposed for construction at station 5+00 on levee 4LSS (plate 6) and at station 258+30 on levee 4RS (plate 16) in order to drain water from low areas in the drainage system. Levee 4RSS was designed as a loop levee and interior runoff will be discharged through the levee during low river stages by corrugated metal pipe culverts with automatic flap gates. Outlet ditches from the drainage culverts will have a minimum bottom width of 12 feet and 1 on 1 side slopes. It will be necessary, in connection with the levee construction, to alter or to relocate utility pipeline crossings at levee stations 489+00 (5RSS) and 199+00 (3RS). It is possible that additional alterations or relocations may be required which have not been determined.

(3) Remaining channel work. Channel realinement and floodway clearing will be required where proposed levees will cut off the

natural channel. This will occur on the South Sulphur River adjacent to levee 4LSS (plate nos. 7, 8, & 9) and on the Sulphur River adjacent to levee 4RS (plate nos. 15, 17, & 18). On the South Sulphur River, the alinement of levee 4LSS will require the construction of approximately 19,000 feet (3.6 miles) of realined channel with a bottom width of 12 feet and flanked on both sides by a 75-foot cleared floodway measured from the centerline of the channel. This construction will require the excavation of approximately 451,000 cubic yards of material and the clearing of approximately 65 acres of land. On the Sulphur River in the vicinity of levee 4RS, a reach of approximately 31,900 feet (6.0 miles) of realined channel and cleared floodway will be required. This entire reach was previously cleared to the required 150-foot width but only 16,000 feet (3.0 miles) of 12-foot bottom width realined channel was previously excavated. The construction of 15,900 feet (3.0 miles) of realined channel is the remaining requirement. This will involve the excavation of approximately 192,000 cubic yards of material. Some minor reclearing and reexcavation in the previously completed area may be necessary in order to restore the area to the required condition. In conjunction with the construction of the realined channel, the existing river channel will be plugged in 6 locations as shown on plates 7, 15, 16, and 17.

DISPOSAL AREAS AND QUANTITY OF MATERIALS:

a. Cooper Dam. (See plate 2.) The construction of the dam and spillways as previously described, will involve the placement of approximately 6,360,000 cubic yards of fill material on 410 acres of land within the dam site. This material has been laboratory tested and in general classified as principally fat and lean clays with a few silty strata. Prior to the placement of the fill material, approximately 197,000 cubic yards of top material will be stripped from the damsite and placed either in the borrow areas, or in the 40-acre disposal area shown. Approximately 2,482,000 cubic yards of additional material will be excavated from the damsite. The latter excavated material will be used in the dam embankment to the maximum extent possible, and the portion that is unsuitable for that purpose will be placed in the borrow areas or in the disposal area shown. Of the total 450 acres within the damsite and the disposal area, approximately 60 acres are considered to be wetlands because they are periodically inundated bottomland hardwoods adjacent to the South Sulphur River, with vegetation typically adapted to saturated soil conditions for growth and reproduction; namely, cedar elm, green ash, boxelder, swamp privet, bitter pecan, buttonbush, and black willow.

The relocation of Farm-to-Market Road 1528, as shown on plate 5, is necessary to avoid inundation by the lake and will involve the construction of bridges over Johns Creek and Doctors Creek and the construction of nearly a mile of roadway embankment. This work will involve the placement of approximately 190,000 cubic yards of fill material, similar to that previously described, for the roadway embankment on approximately 20 acres of wetlands, similar to those

described above, within the Cooper Lake area. The fill material will be obtained from a nearby borrow area which lies within the boundaries of the lake.

b. Remaining Levee Work Downstream from the Lake. The completion of the remaining downstream levee work will require the placement of approximately 5,325,000 cubic yards of dredged or fill material, similar to that described in paragraph a. above, on 347 acres of wetlands, in the Sulphur River Basin as indicated in the following tabulation and as illustrated on plate 2 and on plates 6 thru 8 and 10 thru 18. The areas shown within the levee rights-of-way are considered wetlands and are characterized by bottomland hardwoods as described in paragraph a. above; although, some small portions of the rights-of-way have been cleared.

Levee 3/	Stream	Length (ft)	Length (mi)	Volume (C.Y.)	Area (Acre)
(Ext) 4RSS (Spur)	South Sulphur	5,000	0.9	25,000	5.5
(Ext) 4LSS	South Sulphur	25,100	4.7	225,000	36.5
(Ext) 3RS (Spur)	Sulphur	4,284	0.8		
(Ext) 3RS	Sulphur	22,000	4.2	2,850,000 1/	154.5 2/
(E) 3RS	Sulphur	34,544	6.5		
(N) 4RS	Sulphur	51,600	9.8	2,195,000	150.5
		142,528	26.9	5,325,000 C.Y.	347.0

E - Levee enlargement
Ext - Levee extension
N - New levee
1/ - Total 3RS
2/ - Existing levee 3RS occupies approximately an additional 35.5 acres

Bank of River (Right of Left Bank
Designation Looking Downstream)

3/ Levee Designation 4 R SS

Consecutive Levee Numbering
Increasing Downstream

River to which levee
is adjacent (can be
S or SS for
Sulphur River or
South Sulphur Rv.)

Fill material for the construction of the levees will be obtained from borrow areas within the right-of-way boundaries and from the material excavated in the construction of new channels and landside drainage ditches.

c. Remaining Channel Work Downstream from the Lake. The excavation the 34,900 feet (6.6 miles) of realined channel will require the removal

PROPERTIES ADJACENT: Properties immediately adjacent to the dam site consist of both cleared and wooded areas. Approximately 85 percent of the property is cleared and used for livestock grazing while approximately 15 percent consists of bottomland hardwoods. Approximately 90 percent of the property immediately adjacent to the levee and channel disposal sites consists of bottomland hardwoods while approximately 10 percent is cleared for use as agricultural crop land and for livestock grazing. There is an oilfield east of Talco in Titus County in the vicinity of levee 3RS Extension and levee 4RS; however, these levees will not interefere with the operation of the oilfield.

DREDGING BY OTHERS: There are no other known or anticipated related activities involving the disposal of dredged or fill material in the project area. Any such activity which would impact the waters of the United States would require a permit from the US Army Corps of Engineers under Section 404 of the Federal Water Pollution Control Act Amendments of 1972. A full review would be conducted in each instance to determine whether the activity best serves the public interest.

DESIGNATION OF DISPOSAL SITES: Designation of the proposed disposal sites for dredged material associated with this Federal project shall be made through the application of guidelines promulgated by the Administrator EPA in conjunction with the Secretary of the Army (40 CFR 230).

CULTURAL RESOURCE CONSIDERATIONS: The National Register of Historic Places dated 1 February 1977 and monthly supplements thereto have been consulted and there are no National Register properties to be affected by the project. In accordance with the provisions of 36 CFR 800, the proposed Cooper Lake Archeological District has been determined to be eligible for inclusion in the National Register of Historic Places. This district encompasses portions of all natural environmental zones adjacent to the South Sulphur River and includes nine prehistoric archeological sites. These sites have been evaluated or excavated by Southern Methodist University, beginning in 1970 and nearing completion with a final report currently being prepared. The New Orleans District is now in the process of entering into a Memorandum of Agreement with the Advisory Council on Historic Preservation in accordance with the provisions of 36 CFR 800.

Archeological site 41TT40, located in the vicinity of mile 152 of the Sulphur River, will be impacted by the construction of levee 4RS. During the further detailed planning of this levee work, this site will be evaluated for National Register-eligibility according to the criteria in 36 CFR 800.10. If found to be significant, the site will be mitigated or avoided.

Specifications for all work on the project will provide for preservation of any items of apparent historical or archeological interest which may be discovered during the course of construction activities. The

construction contracts will require immediate cessation of work and notification of appropriate authorities, should any items of this nature be encountered. The work shall not commence again at that specific location until the new site is evaluated, and if found to be significant, mitigated.

COORDINATION: A copy of this notice is being sent to the following list of agencies for coordination purposes:

Region VI, Environmental Protection Agency
US Department of the Interior, Bureau of Mines
US Department of the Interior, Bureau of Reclamation
US Department of the Interior, Bureau of Land Management
US Department of the Interior, US Fish and Wildlife Service
US Department of the Interior, Geological Survey
US Department of the Interior, National Park Service
US Department of the Interior, Bureau of Sport Fisheries and Wildlife
US Department of the Interior, Heritage Conservation & Recreation Service
US Department of Commerce, National Marine Fisheries Service
US Department of Commerce, National Geodetic Survey
US Department of Commerce, National Oceanic and Atmospheric Administration
US Department of Agriculture, Soil Conservation Service
US Department of Agriculture, Forest Service
US Department of Transportation, Federal Highway Administration
Advisory Council on Historic Preservation
Council on Environmental Quality
Texas State Department of Highways and Public Transportation
Texas State Forest Service
Texas Department of Water Resources
Texas Parks and Wildlife Department

Other Federal, state, and local organizations, including United States Senators and Representatives of Texas and Arkansas, are also sent copies of this notice and asked to participate in coordinating this proposed work.

ENVIRONMENTAL IMPACT STATEMENT: The final environmental statement for the Cooper Lake and Channels, Texas project was filed with the President's Council on Environmental Quality on 24 June 1977 and notice of its availability was posted in the Federal Register on 1 July 1977. Single copies are available without cost upon written request to the following address: District Engineer, New Orleans District, US Army Corps of Engineers, PO Box 60267, New Orleans, Louisiana 70160, ATTN: LMNPD-RE.

RELATED LAWS: Laws under which the proposed work is to be reviewed are as follows:

Federal Water Pollution Control Act Amendments of 1972

and disposal on wetlands of 643,000 cubic yards of dredged material, similar to that described in paragraph a. above, in the vicinity of levees 4LSS and 4RS as previously described and as illustrated on plates 7 thru 9, 15, 17, and 18. The areas shown within the channel rights-of-way are considered wetlands and are characterized by bottomland hardwoods as described in paragraph a. above; although, portions of the rights-of-way have been cleared. To the extent practicable, the dredged material will be utilized in the construction of the six channel plugs and in the nearby levee construction. Dredged material which is suitable for these purposes will be disposed in the uncompacted disposal areas as shown.

These disposal areas are parallel to and on both sides of the realined channel and extend from the edge of the floodway clearing to the right-of-way limit. However, the limits of the disposal area are further governed by a requirement that disposed material will be placed no closer than 50 feet from the top edge of the excavated channel in order that future enlargement of the channel will not remove the disposed material and no closer than 5 feet from the right-of-way limit in order to prevent erosion of the disposed material onto the land adjacent to the right-of-way. The embankments of disposed material will be limited in height to about 10 feet and openings will be left in the disposal areas as required to provide for natural drainage. Approximately 140 acres of wetlands will be used for disposal areas. These wetlands are characterized by bottomland hardwoods as described in paragraph a. above. Additionally, any material requiring disposal as a result of minor redredging which may be required in the previously completed channel illustrated on plates 15 thru 17 will be placed in the previously utilized disposal area adjacent to the cleared floodway as shown. This previously utilized area occupies approximately 65 acres of wetlands.

METHOD OF DISPOSAL AND COMPOSITION OF MATERIAL: Channel construction will be accomplished by land based equipment. Various types of land based earth moving equipment will be used to haul and place material for the levees and the dam and highway embankments. The construction work on the levees and channels is estimated to last 1 1/2 years while construction work on the dam is estimated to take 4 1/2 years. The relocation of FM 1528 will take approximately 1 year. The material to be placed as previously described has been laboratory tested and in general, classified as principally fat and lean clays with a few silty strata.

WATER QUALITY: The construction phase of the project will produce several localized short term water quality impacts. These will include: 1) increased turbidity, 2) depression of dissolved oxygen, 3) minor releases of metals to the water column, and 4) a general warming of the surface waters due to the absorption of radiant energy by the suspended particles.

Marine Protection Research and Sanctuaries Act of 1972
National Environmental Policy Act of 1969
Fish and Wildlife Act of 1956
Migratory Marine Game - Fish Act
Fish and Wildlife Coordination Act
Endangered Species Act of 1973
National Historic Preservation Act of 1966
Preservation of Historic and Archeological Data Act of 1973

GENERAL INFORMATION: The benefits which reasonably may be expected to accrue from the proposal have been balanced against their reasonably foreseeable detriments. All factors which may be relevant to the proposal have been considered; among those are conservation, economics, esthetics, general environmental concerns, historic values, fish and wildlife values, land use classification, recreation, water quality, and in general, the needs and welfare of the people.

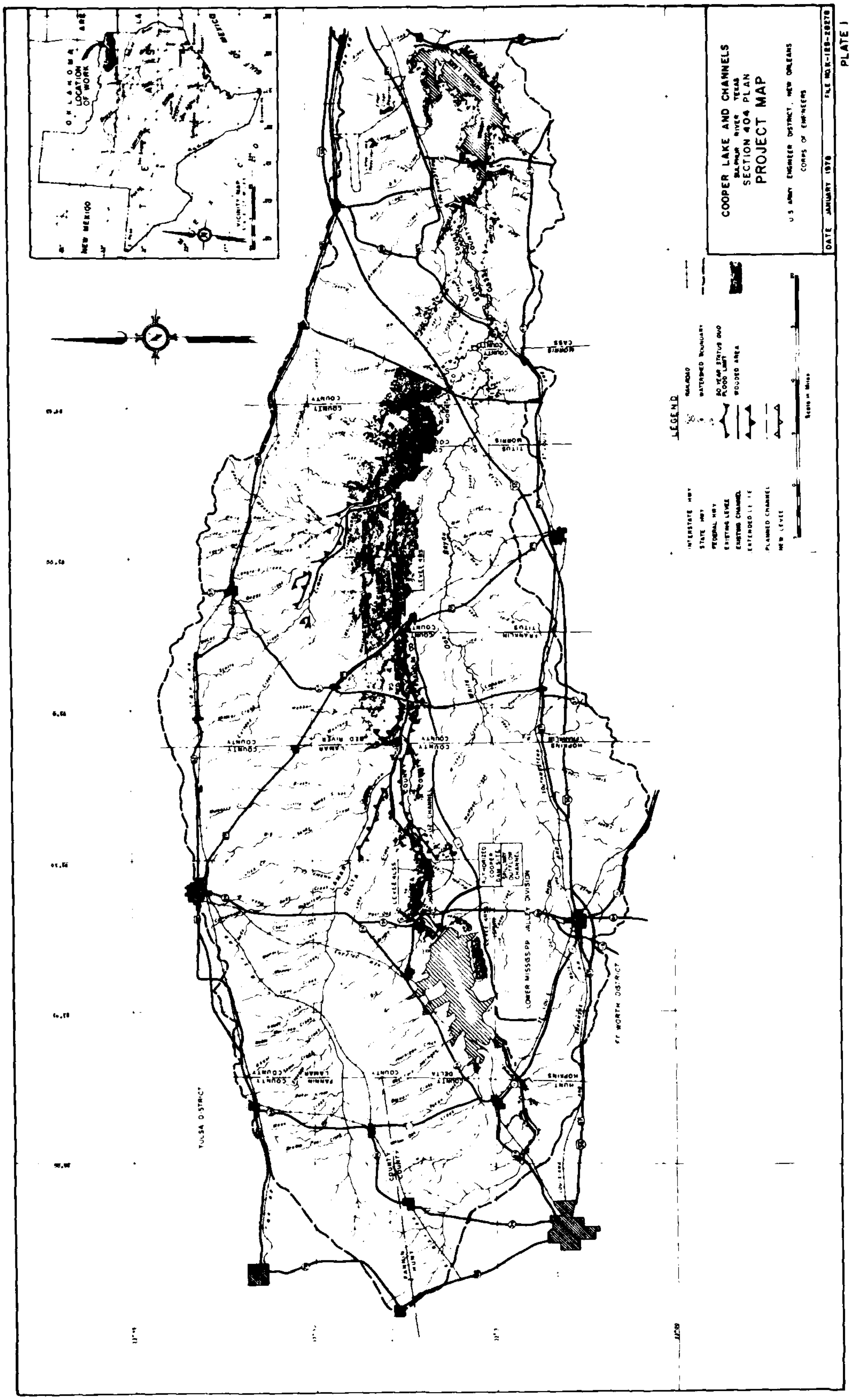
Interested persons may submit comments on the proposed disposal of dredged or fill material into the waters of the United States including protests, objections, or suggested modifications. It is requested that this be done by 27 March 1978.

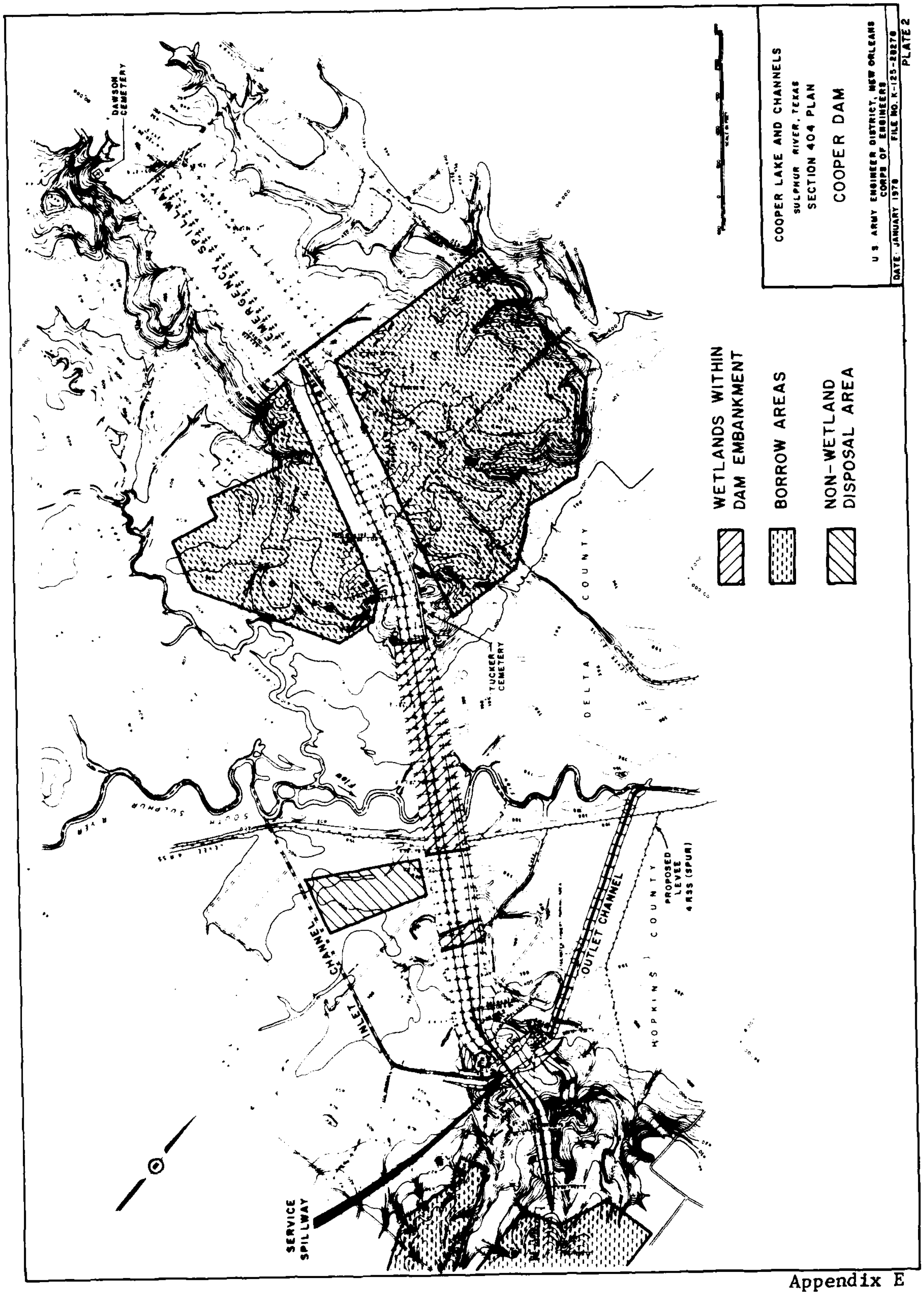
Additionally, any person may request that a public hearing be held to consider the proposed disposal of dredged or fill material into the waters of the United States. Any such request for a public hearing must be submitted in writing to the District Engineer not later than 27 March 1978 and must state, with particularity, the reasons for holding a hearing.

You are requested to communicate the information contained in this notice to any other parties who may have an interest in the proposed activities.

18 Incl
as

EARLY J. RUSH III
Colonel, CE
District Engineer


COOPER LAKE AND CHANNELS
SULPHUR RIVER TEXAS
SECTION 404 PLAN
PROJECT MAP
U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS
DATE JANUARY 1978
PLATE I
LEGEND
TULSA DISTRICT
FT WORTH DISTRICT
LOWER MISSISSIPPI VALLEY DIVISION



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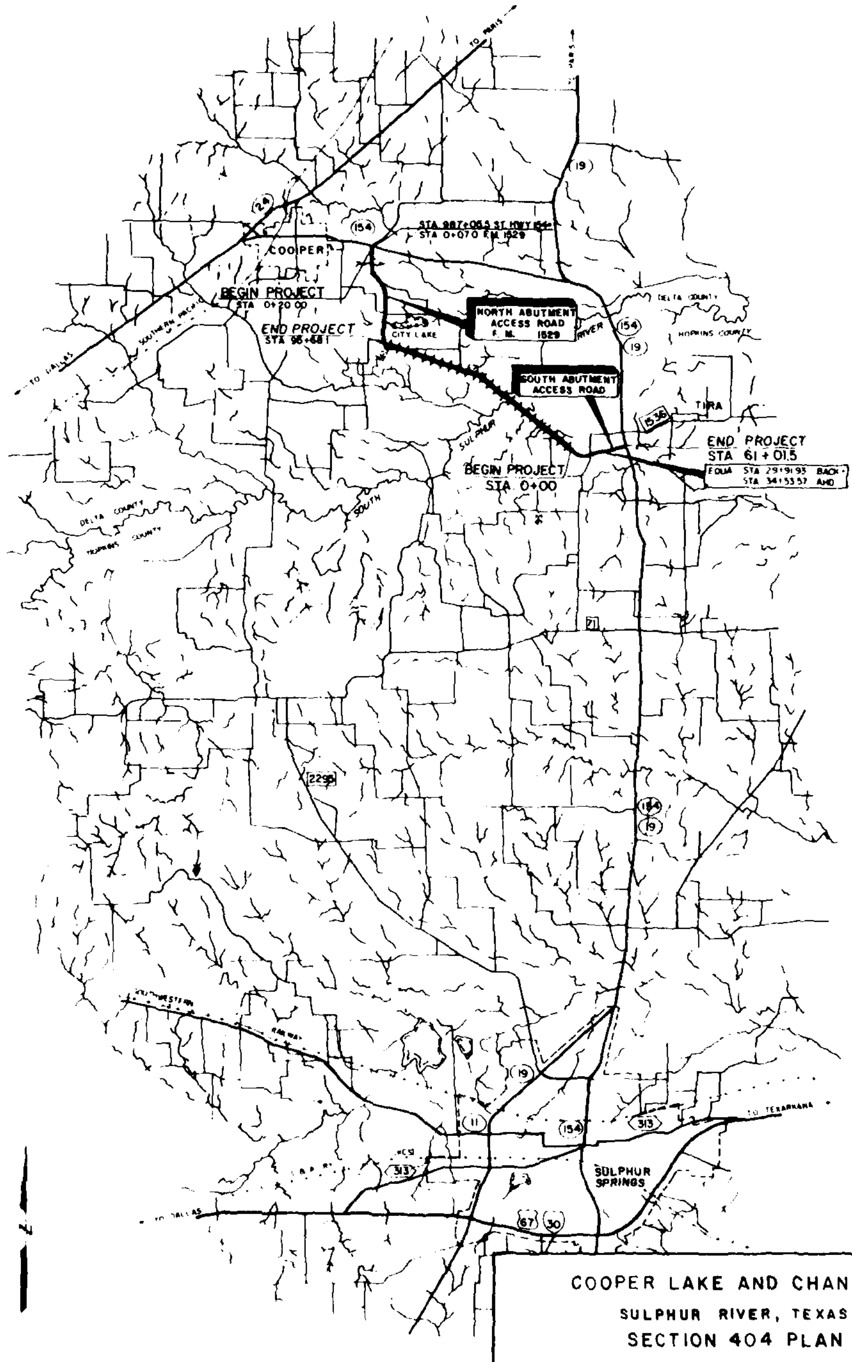

COOPER LAKE AND CHANNELS

SULPHUR RIVER, TEXAS

SECTION 404 PLAN

COOPER DAM
ACCESS ROADS

U.S. ARMY ENGINEER DISTRICT, NEW ORLEANS
CORPS OF ENGINEERS

DATE JANUARY 1978 FILE NO. K-126-28278

PLATE 3
Appendix E

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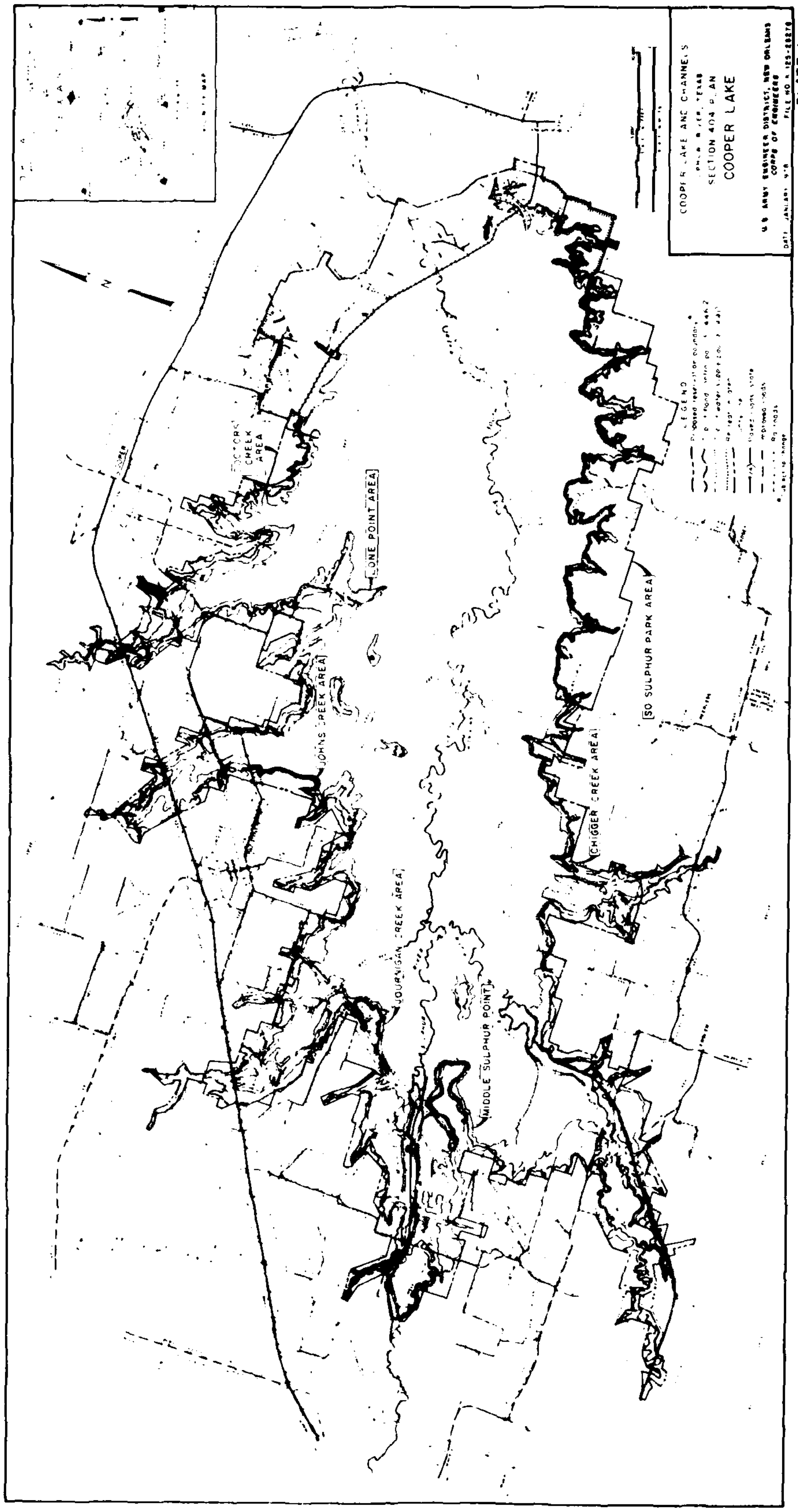
COOPER LAKE
SECTION 404 PLAN
PLATE 4
LEGEND
LONE POINT AREA
JOHNS CREEK AREA
SO SULPHUR PARK AREA
CHIGGER CREEK AREA
JOURNIGAN CREEK AREA
MIDDLE SULPHUR POINT

Appendix E

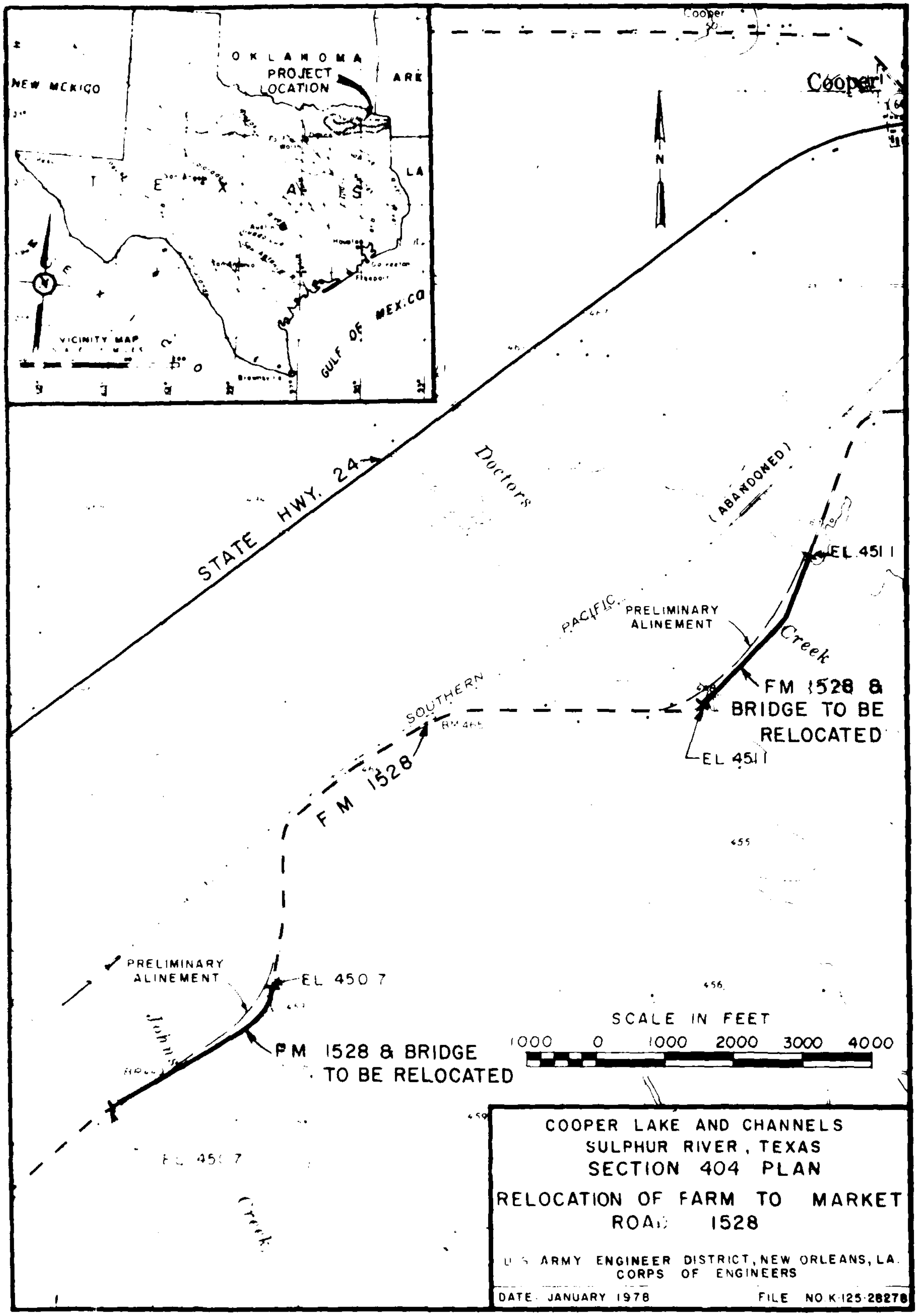

PLATE 5

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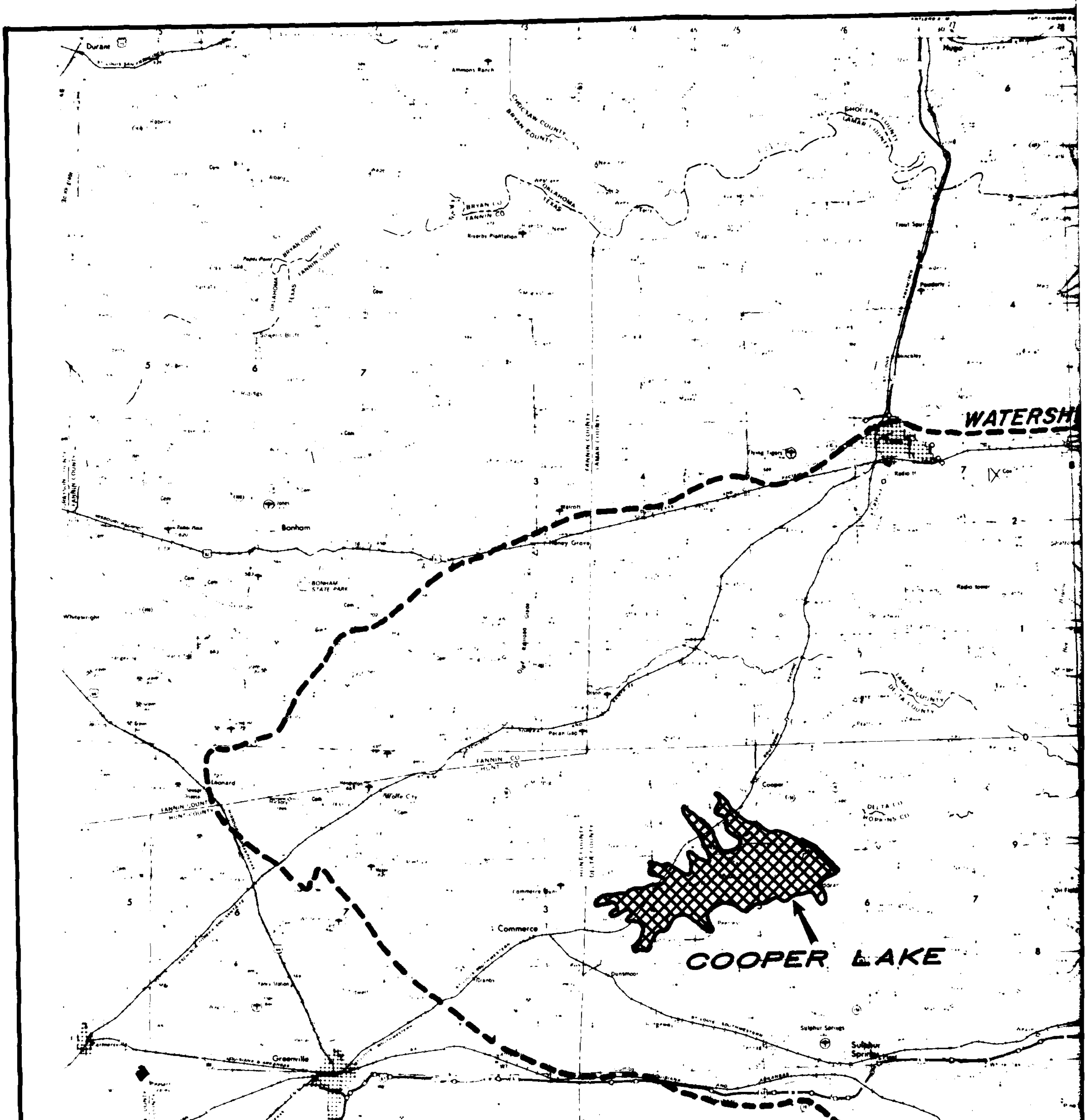
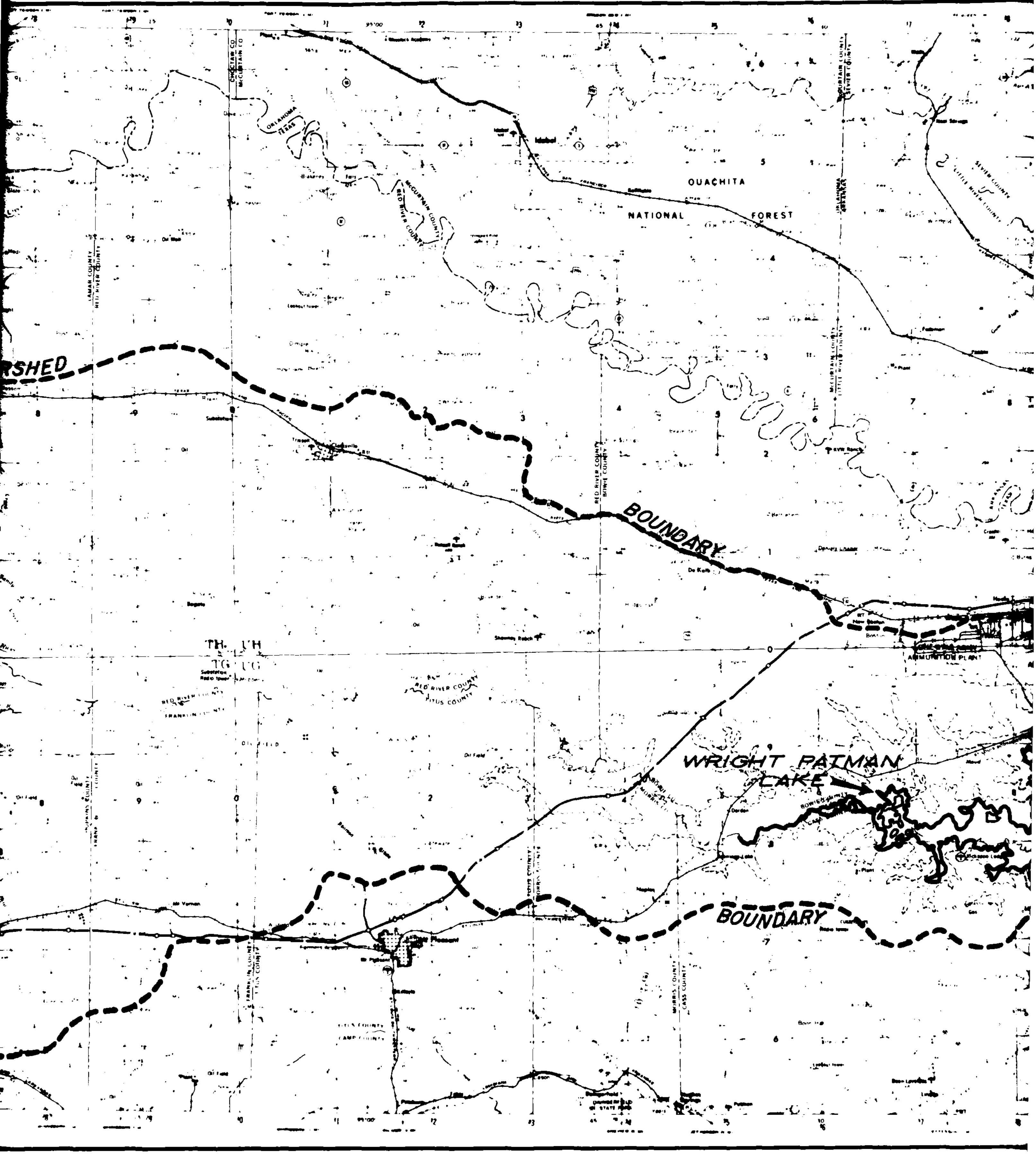
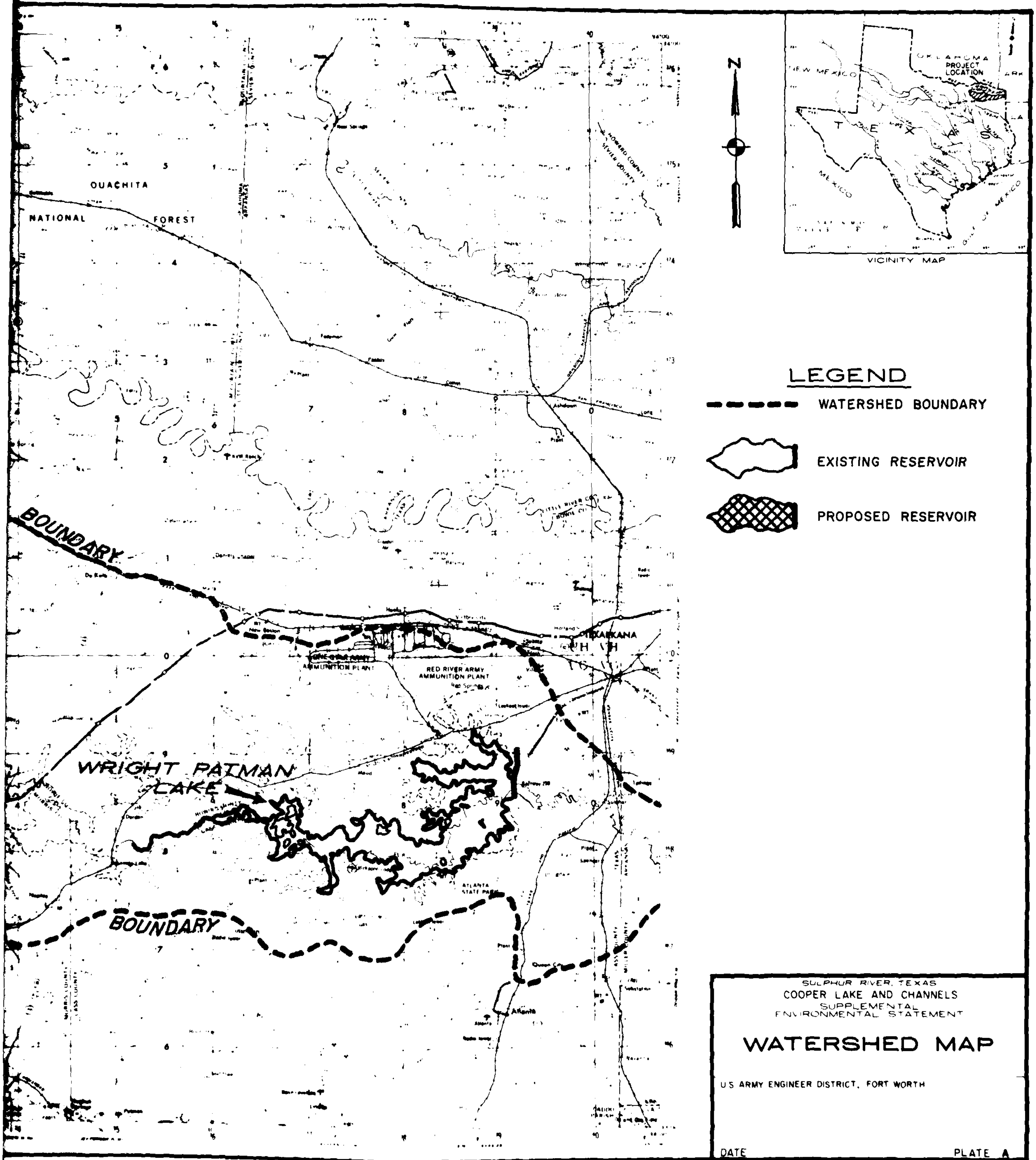
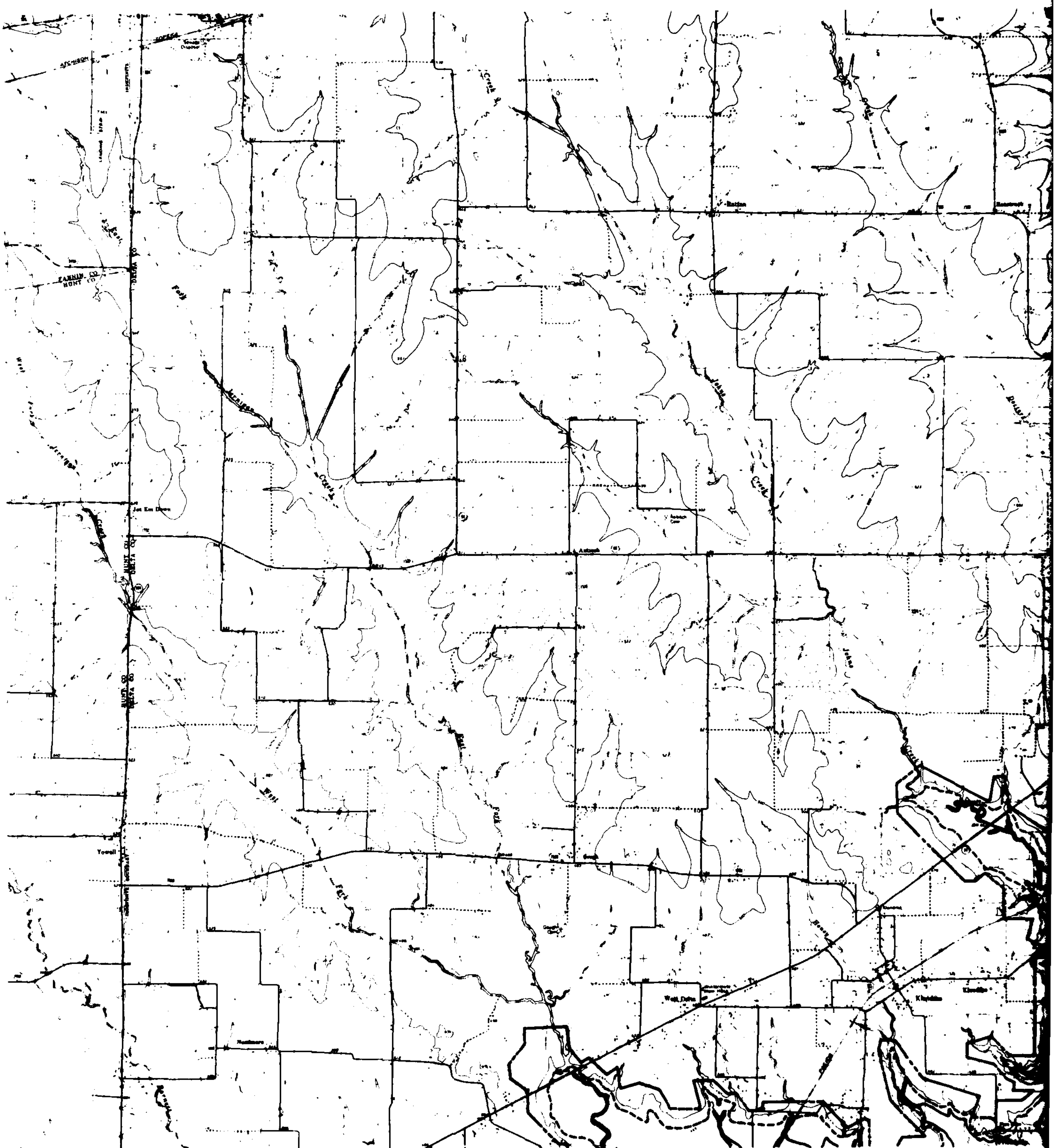

WATERSHED
COOPER LAKE
WATERSHED
Durant
Hugo
Bonham
BONHAM STATE PARK
Honey Grove
Leonard
Wolfe City
Cooper
Commerce
Greenville
Sulphur Springs
DELTA CO
HOPKINS CO
FANNIN CO
HUNT CO
LAMAR COUNTY
DELTA COUNTY
OKLAHOMA
TEXAS



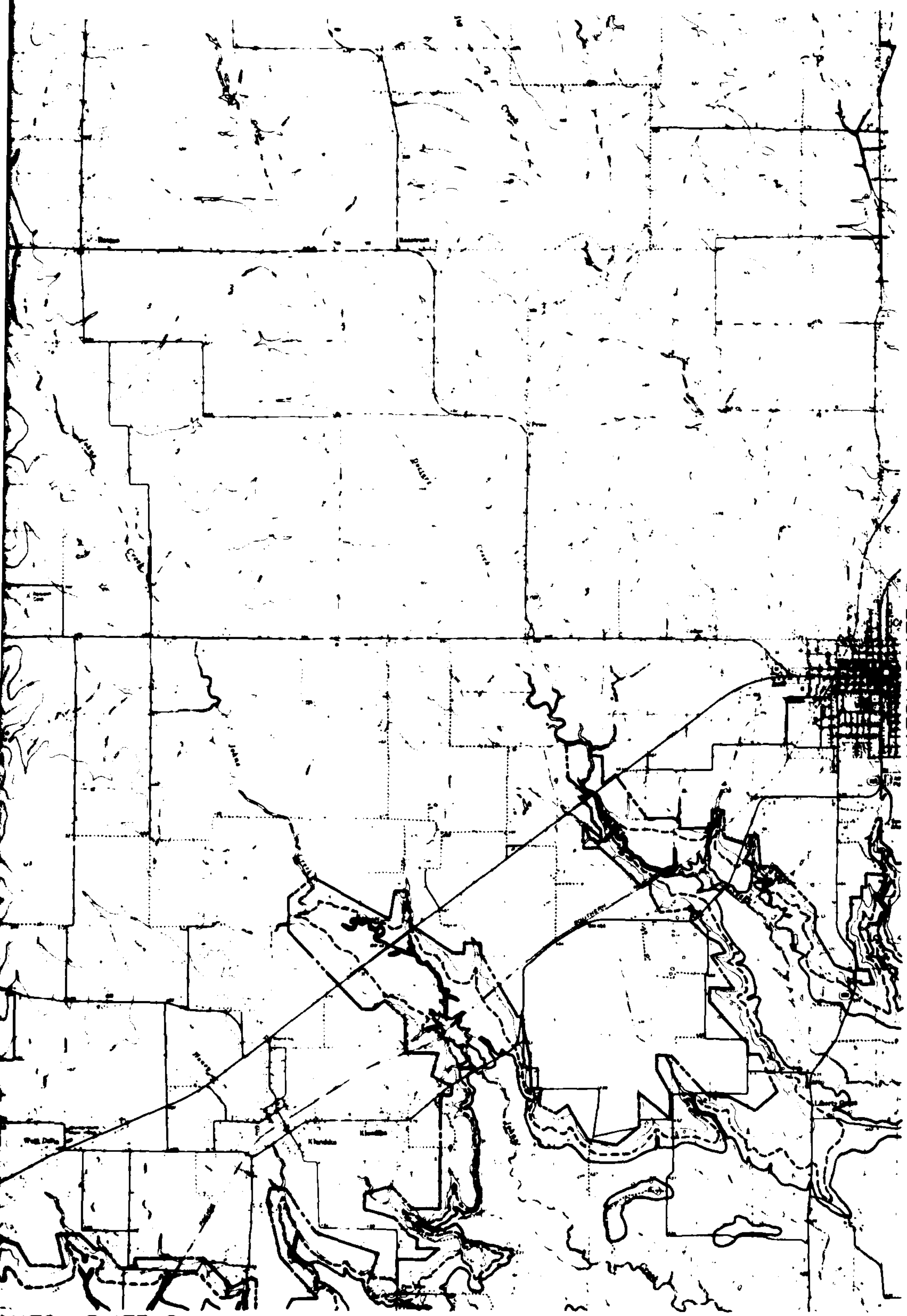
OUACHITA
NATIONAL
FOREST
RSHED
BOUNDARY
AMMUNITION PLANT
RED RIVER COUNTY
TITUS COUNTY
WRIGHT PATMAN
LAKE
BOUNDARY

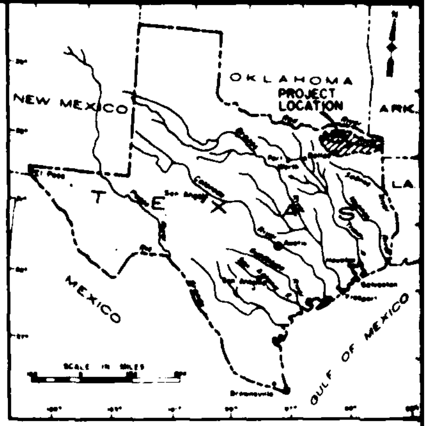

OUACHITA
NATIONAL FOREST
BOUNDARY
TEXARKANA
RED RIVER ARMY AMMUNITION PLANT
WRIGHT PATMAN LAKE
ATLANTA STATE PARK
BOUNDARY
Atlanta
N
NEW MEXICO
OKLAHOMA
PROJECT LOCATION
T E X A S
MEXICO
VICINITY MAP
LEGEND
WATERSHED BOUNDARY
EXISTING RESERVOIR
PROPOSED RESERVOIR
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT
WATERSHED MAP
U S ARMY ENGINEER DISTRICT, FORT WORTH
DATE
PLATE A



MATCH PLATE 2.

U.S. ARMY





VICINITY MAP

KEY MAP

LEGEND

LEVEES

EXISTING LEVEE

LEVEES (COOPER LAKE AND CHANNELS)

COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

NOT COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

CHANNELS (COOPER LAKE AND CHANNELS)

COMPLETED

PROPOSED

COOPER LAKE

WATER SUPPLY POOL EL 440.0

FLOOD CONTROL POOL EL 446.2

GOVERNMENT PROPERTY LINE

MITIGATION LANDS

BANK OF RIVER (RIGHT OR LEFT BANK DESIGNATION LOOKING DOWNSTREAM)

4-R-SS

CONSECUTIVE LEVEE NUMBERING INCREASING DOWNSTREAM

RIVER TO WHICH LEVEE IS ADJACENT (CAN BE S, SS, N, OR C FOR SULPHUR RIVER, SOUTH SULPHUR RIVER, NORTH SULPHUR RIVER AND CUTHAND CREEK, RESPECTIVELY)

2000 0 2000 4000

SCALE OF FEET

SULPHUR RIVER, TEXAS

COOPER LAKE AND CHANNELS

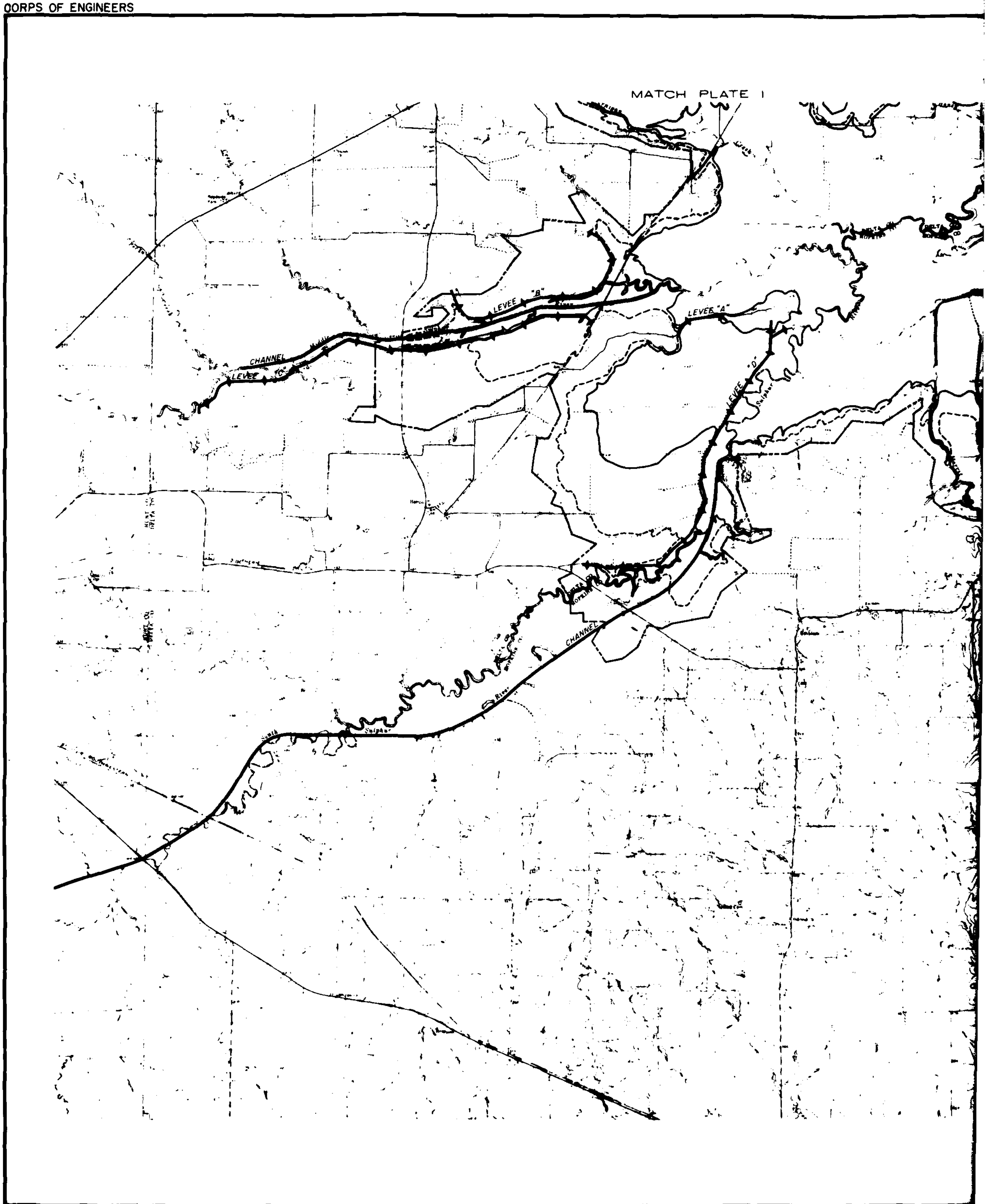
SUPPLEMENTAL ENVIRONMENTAL STATEMENT

FEIS RECOMMENDED PLAN
(RESERVOIR AND LEVEES)

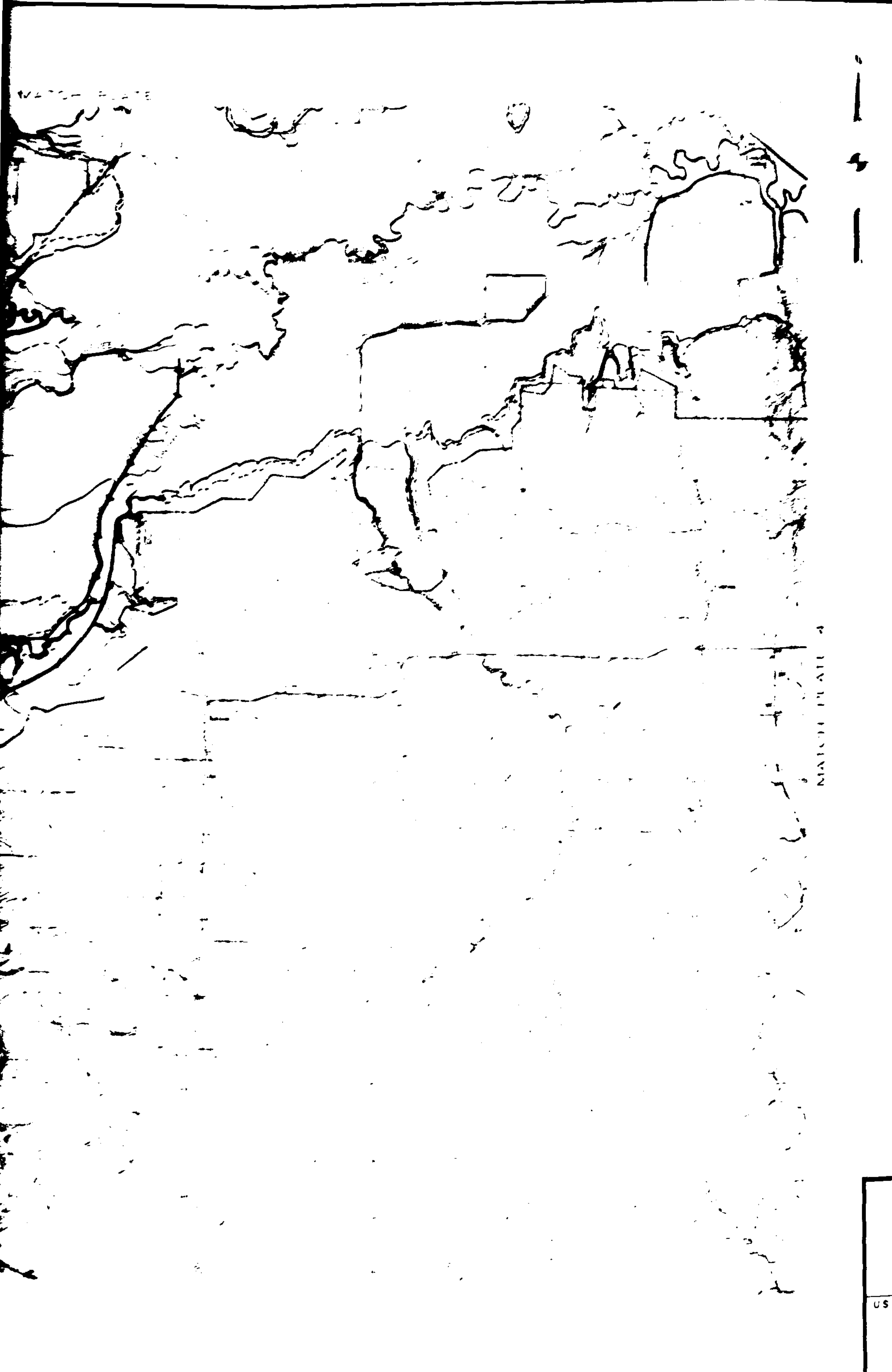
US ARMY ENGINEER DISTRICT, FORT WORTH

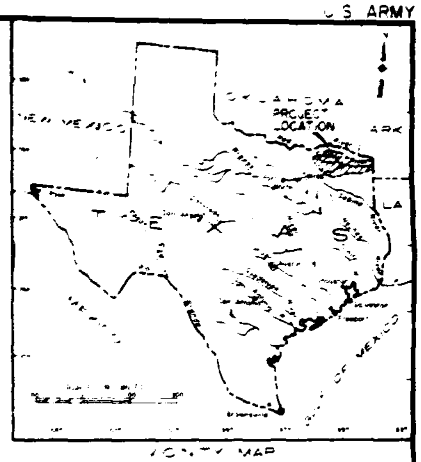
DATE

PLATE


MATCH PLATE I
LEVEE "B"
LEVEE "A"
CHANNEL
LEVEE "C"
LEVEE "D"
CHANNEL
Sulphur
River

U.S. ARMY





VICINITY MAP

KEY MAP

LEGEND

LEVEES

EXISTING LEVEE

LEVEES COOPER LAKE AND CHANNELS

COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

NOT COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

CHANNELS (COOPER LAKE AND CHANNELS)

COMPLETED

PROPOSED

COOPER LAKE

WATER SUPPLY POOL EL 440.0

FLOOD CONTROL POOL EL 446.2

GOVERNMENT PROPERTY LINE

MITIGATION LANDS

4-R-SS

SCALE OF FEET

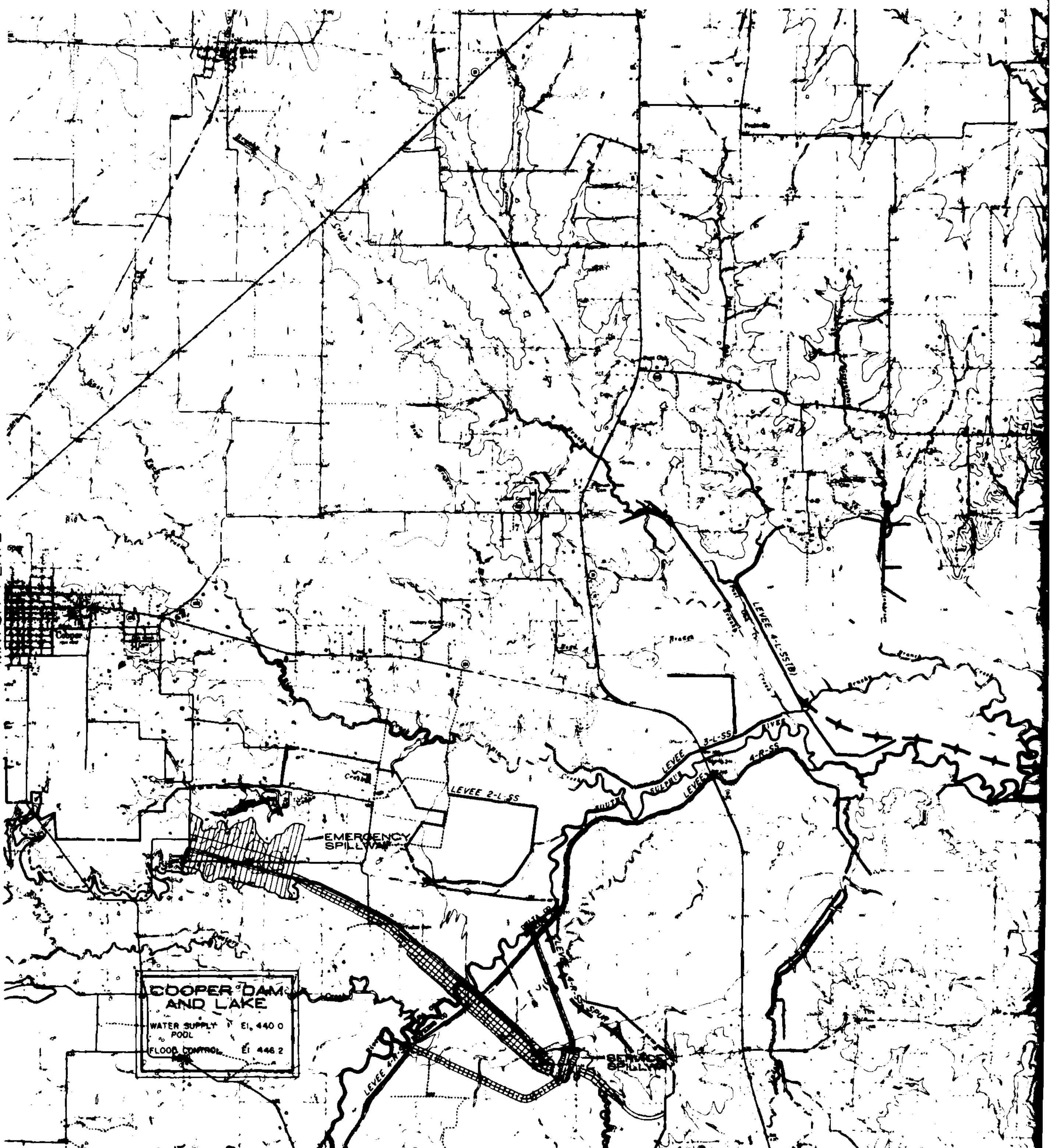
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

FEIS RECOMMENDED PLAN
(RESERVOIR AND LEVEES)

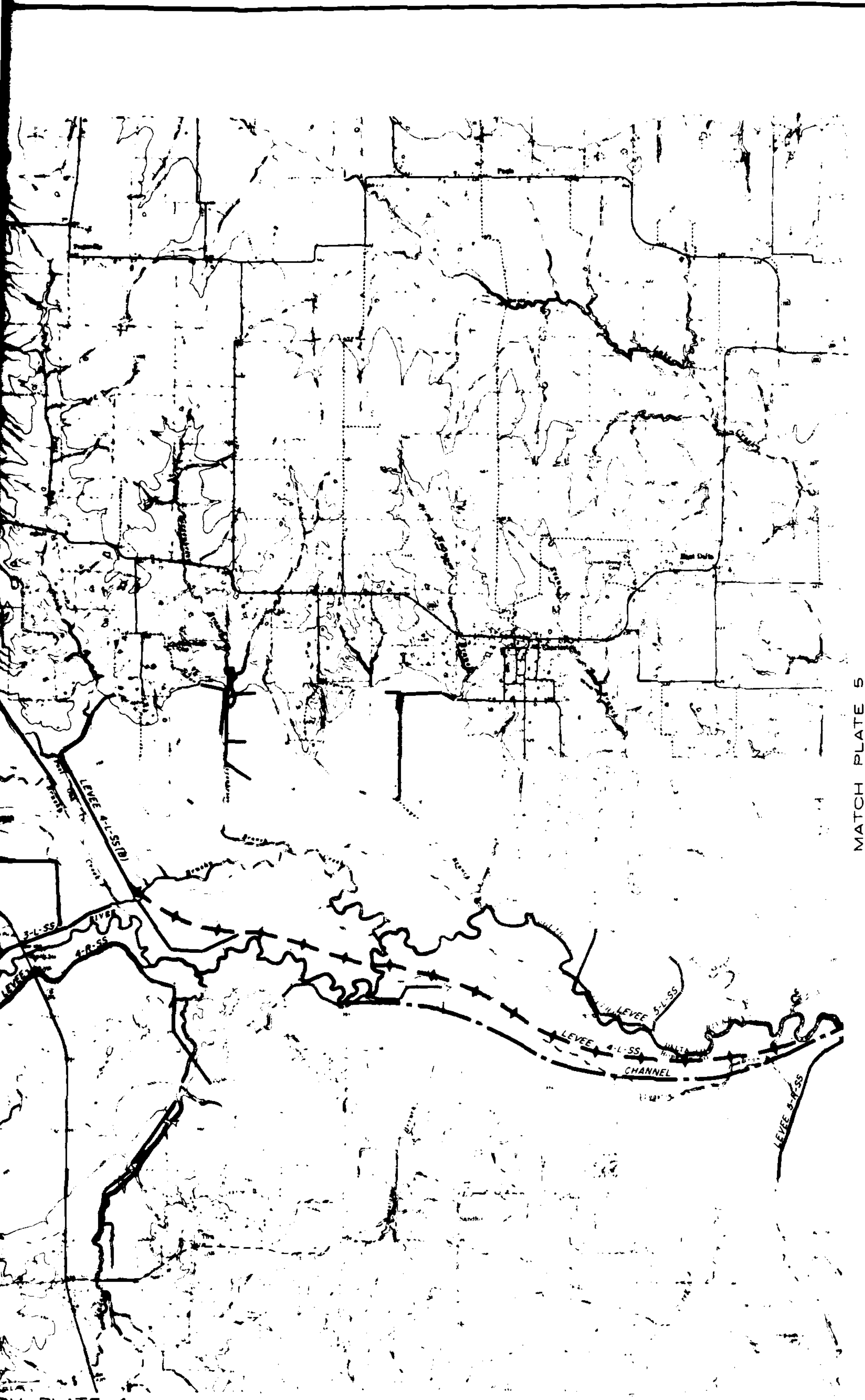
U.S. ARMY ENGINEER DISTRICT, FORT WORTH

DATE

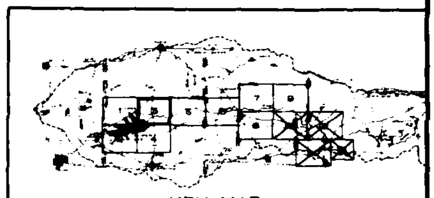
PLATE B-


MATCH PLATE 1
MATCH PLATE 4
COOPER DAM AND LAKE
WATER SUPPLY POOL EL 440.0
FLOOD CONTROL POOL EL 446.2
EMERGENCY SPILLWAY
SERVICE SPILLWAY
LEVEE 2-L-SS
LEVEE 3-L-SS
LEVEE 4-R-SS
LEVEE 4-L-SS(B)
SOUTH SULPHUR RIVER
Cooper

U.S. ARMY



VICINITY MAP



KEY MAP

LEGEND

LEVEES

EXISTING LEVEE

LEVEES (COOPER LAKE AND CHANNELS)

COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

NOT COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

CHANNELS (COOPER LAKE AND CHANNELS)

COMPLETED

PROPOSED

COOPER LAKE

WATER SUPPLY POOL EL 440.0

FLOOD CONTROL POOL EL 446.2

GOVERNMENT PROPERTY LINE

MITIGATION LANDS

BANK OF RIVER (RIGHT OR LEFT BANK DESIGNATION LOOKING DOWNSTREAM)

4-R-SS

CONSECUTIVE LEVEE NUMBERING INCREASING DOWNSTREAM

RIVER TO WHICH LEVEE IS ADJACENT (CAN BE S, SS, N, OR C FOR SULPHUR RIVER, SOUTH SULPHUR RIVER, NORTH SULPHUR RIVER AND CUTHAND CREEK, RESPECTIVELY

2000 0 2000 4000

SCALE OF FEET

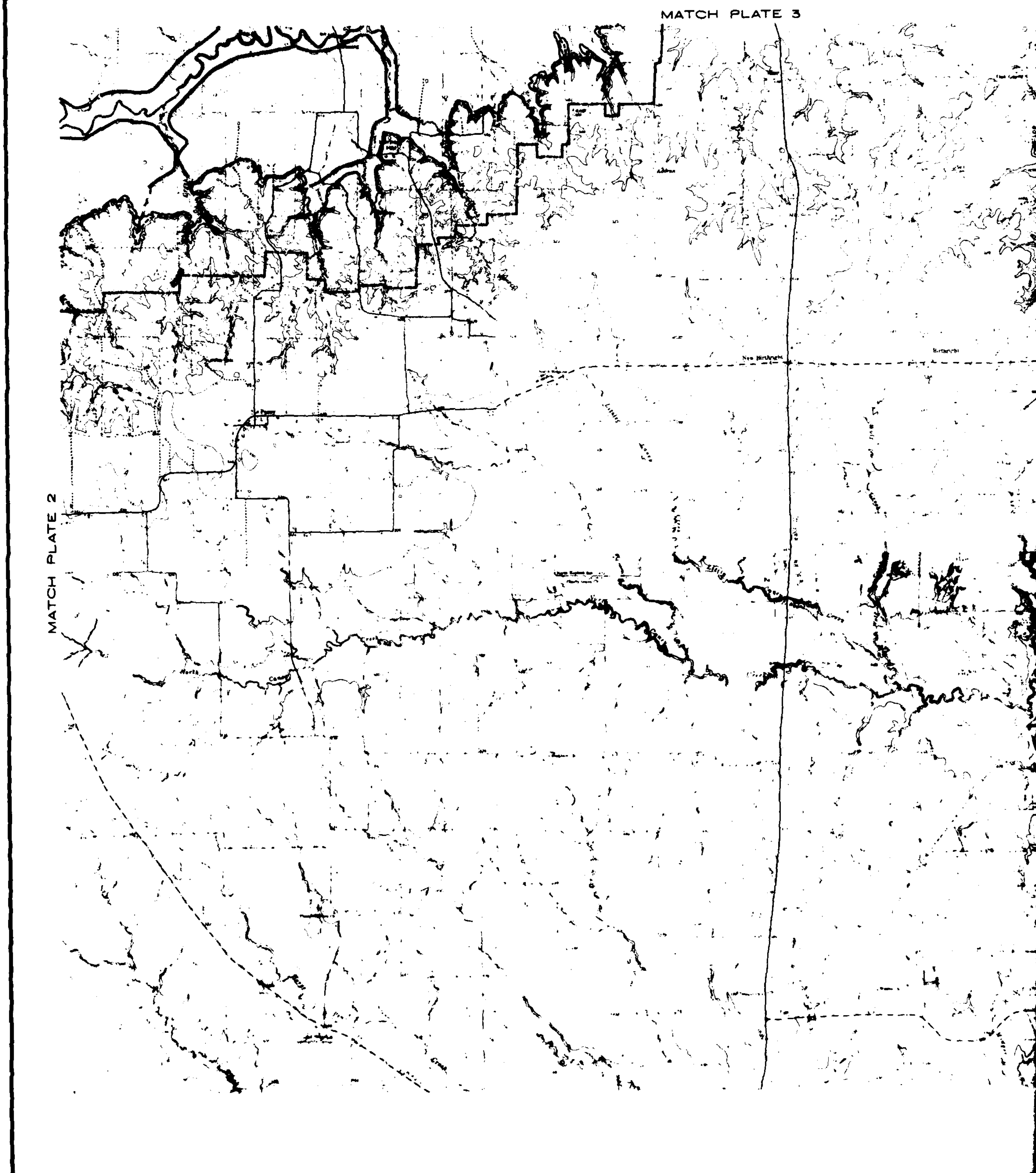
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

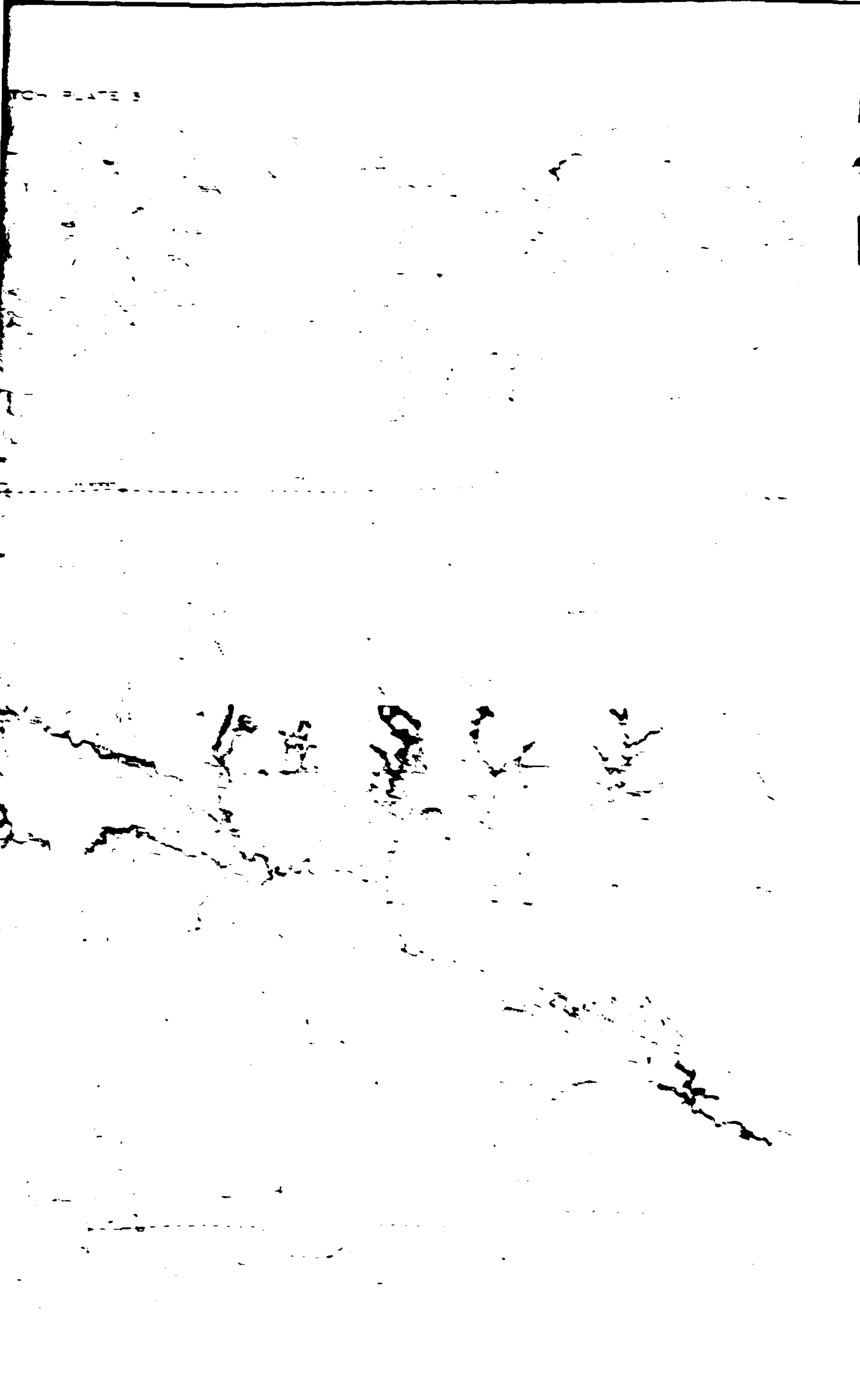
FEIS RECOMMENDED PLAN
(RESERVOIR AND LEVEES)

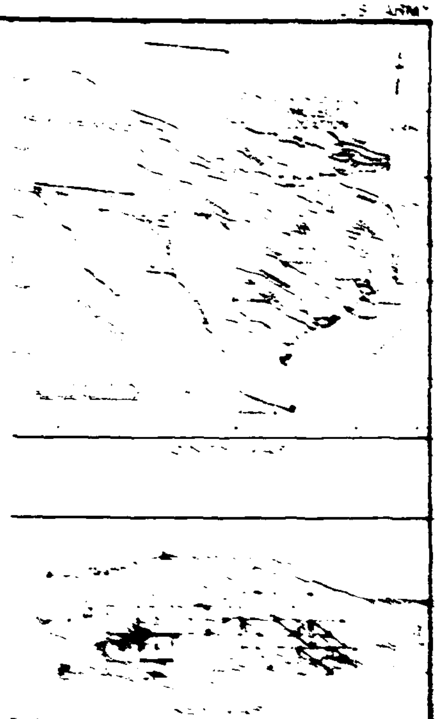
US ARMY ENGINEER DISTRICT, FORT WORTH

DATE

PLATE B-3


MATCH PLATE 3
MATCH PLATE 2





LEGEND

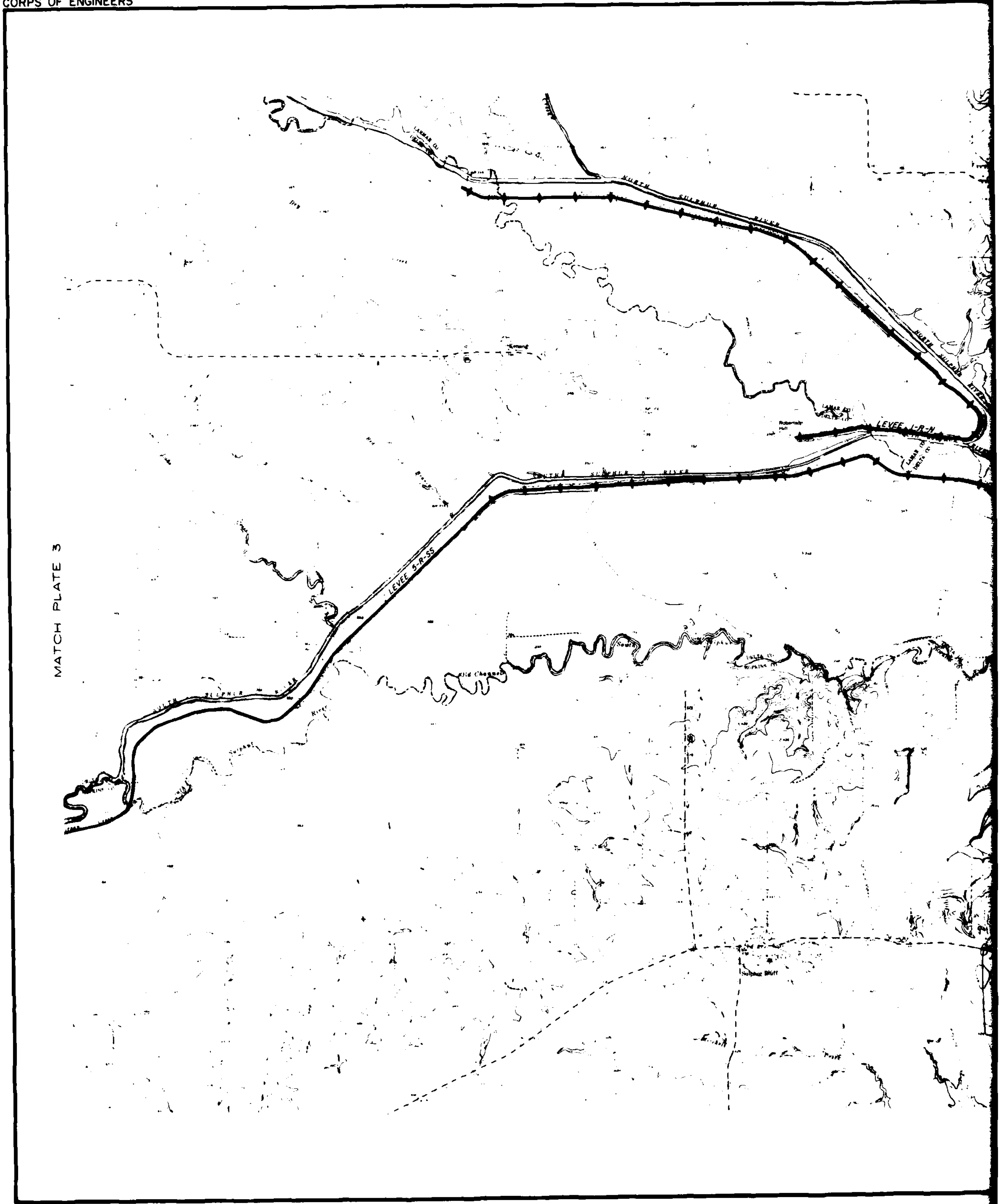
COOPER LAKE AND CHANNELS

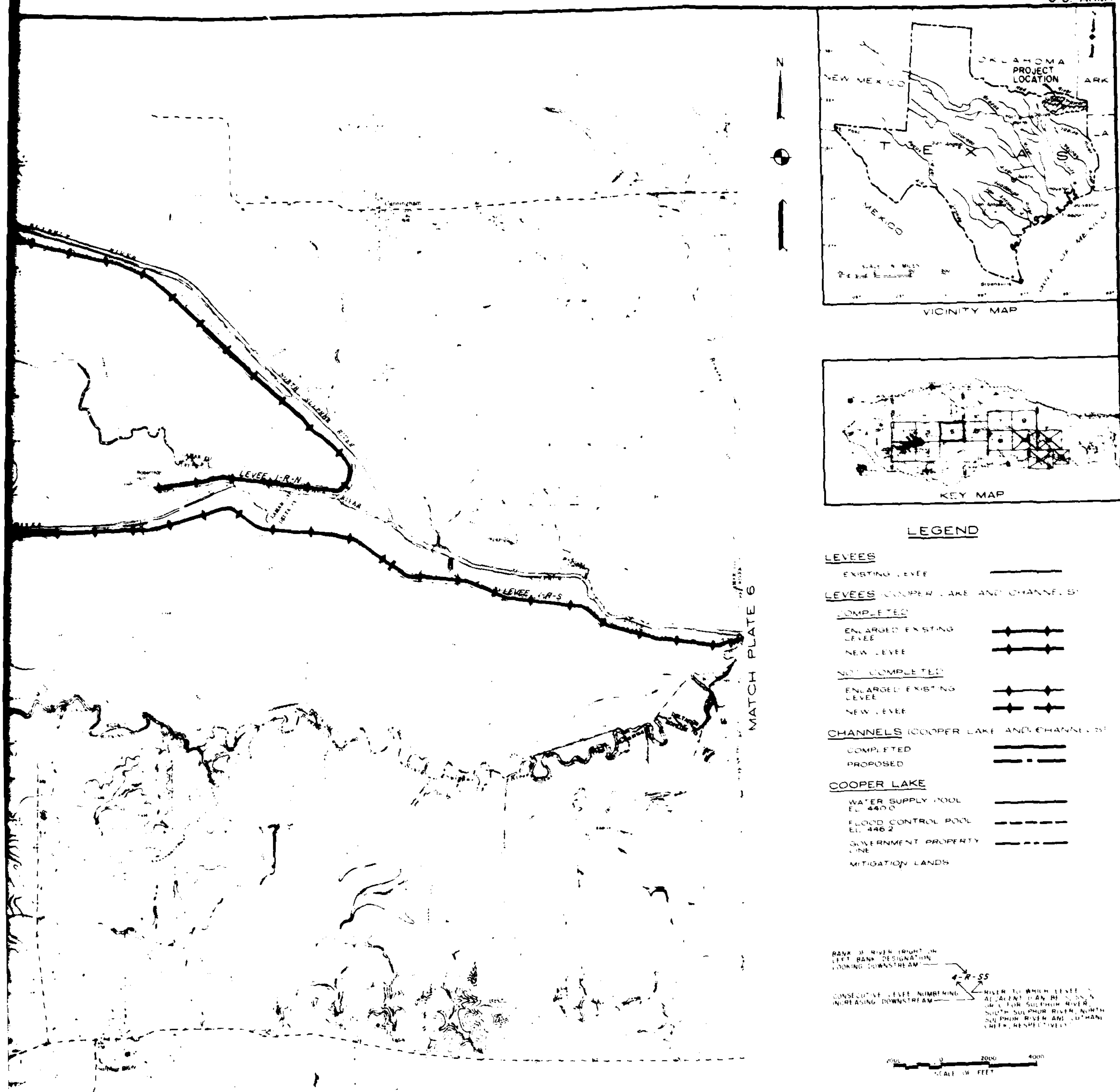
FE'S RECOMMENDED PLAN

RESERVOIR AND LEVEES

ARMY ENGINEER DISTRICT FORT WORTH

CORPS OF ENGINEERS





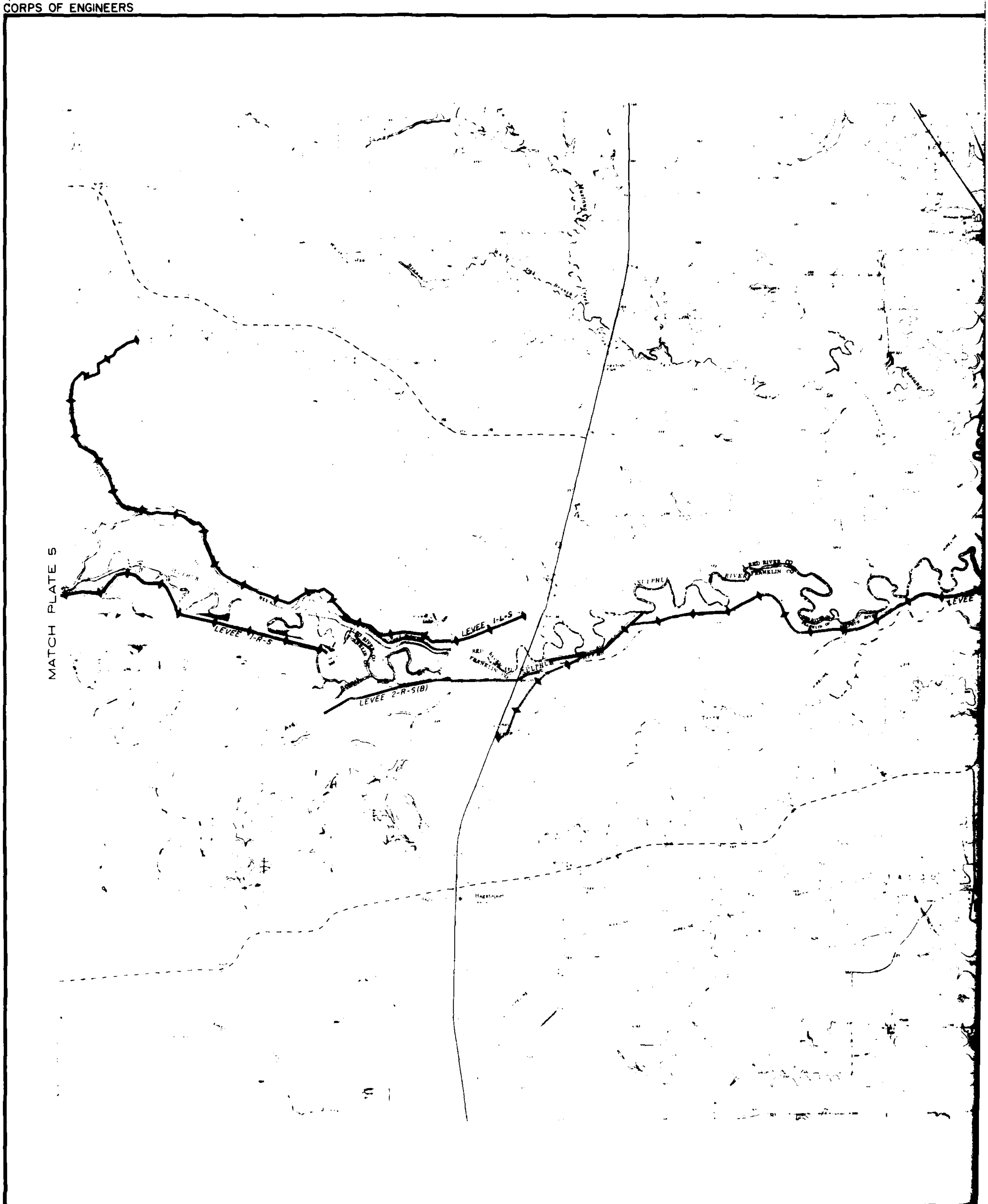
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

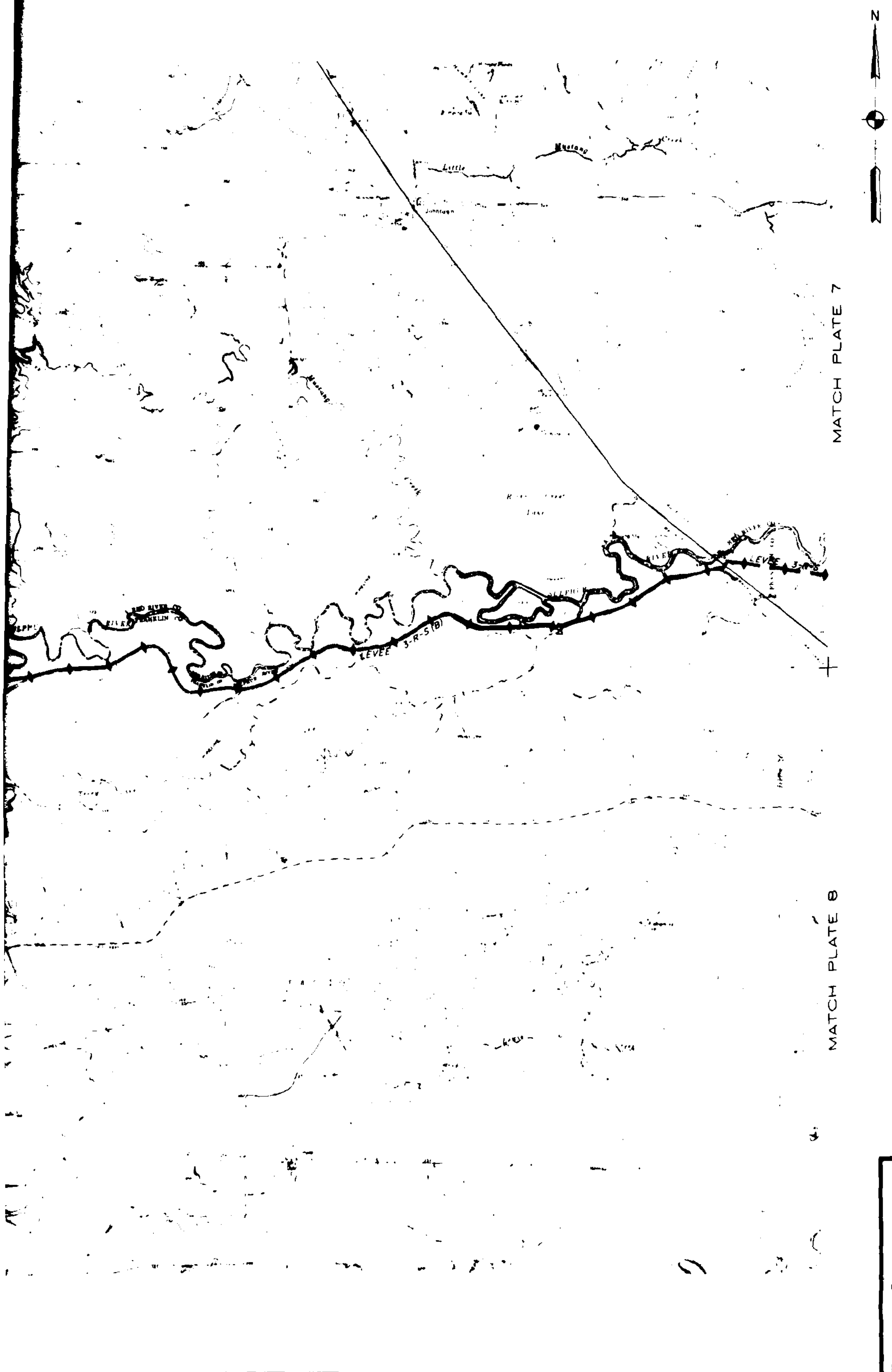
FEIS RECOMMENDED PLAN
(RESERVOIR AND LEVEES)

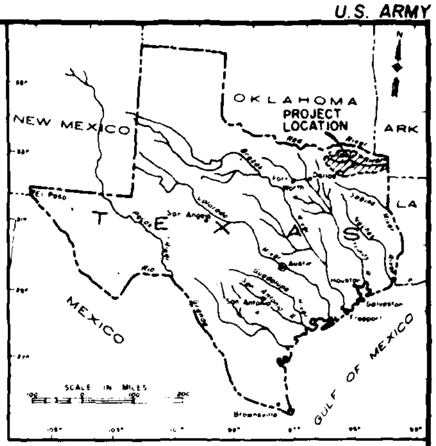
U.S. ARMY ENGINEER DISTRICT, FORT WORTH

DATE

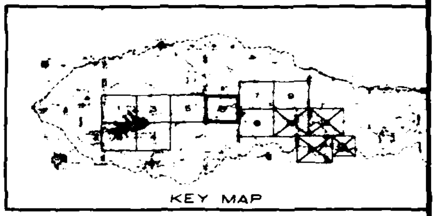
PLATE B-5


MATCH PLATE 5
LEVEE 1-R-S
LEVEE 1-L-S
LEVEE 2-R-S(B)
SULPHUR
SULPHUR RIVER
RED RIVER CO
FRANKLIN CO
LEVEE





VICINITY MAP



KEY MAP

LEGEND

LEVEES

EXISTING LEVEE

LEVEES (COOPER LAKE AND CHANNELS)

COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

NOT COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

CHANNELS (COOPER LAKE AND CHANNELS)

COMPLETED

PROPOSED

COOPER LAKE

WATER SUPPLY POOL EL 440.0

FLOOD CONTROL POOL EL 446.2

GOVERNMENT PROPERTY LINE

MITIGATION LANDS

BANK OF RIVER (RIGHT OR LEFT BANK DESIGNATION LOOKING DOWNSTREAM)

4-R-SS

CONSECUTIVE LEVEE NUMBERING INCREASING DOWNSTREAM

2000 4000

SCALE IN FEET

SULPHUR RIVER, TEXAS

COOPER LAKE AND CHANNELS

SUPPLEMENTAL ENVIRONMENTAL STATEMENT

FEIS RECOMMENDED PLAN

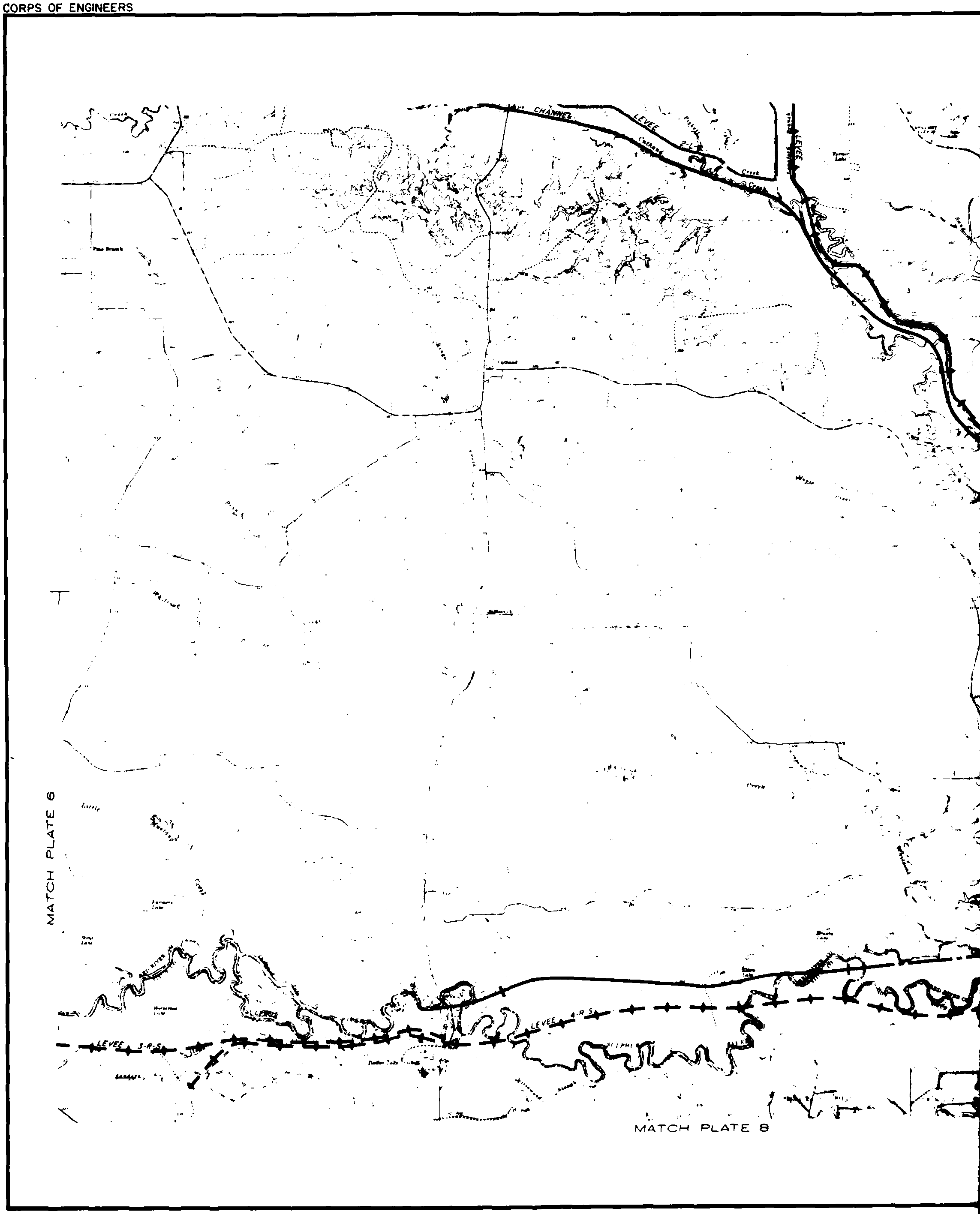
(RESERVOIR AND LEVEES)

US ARMY ENGINEER DISTRICT, FORT WORTH

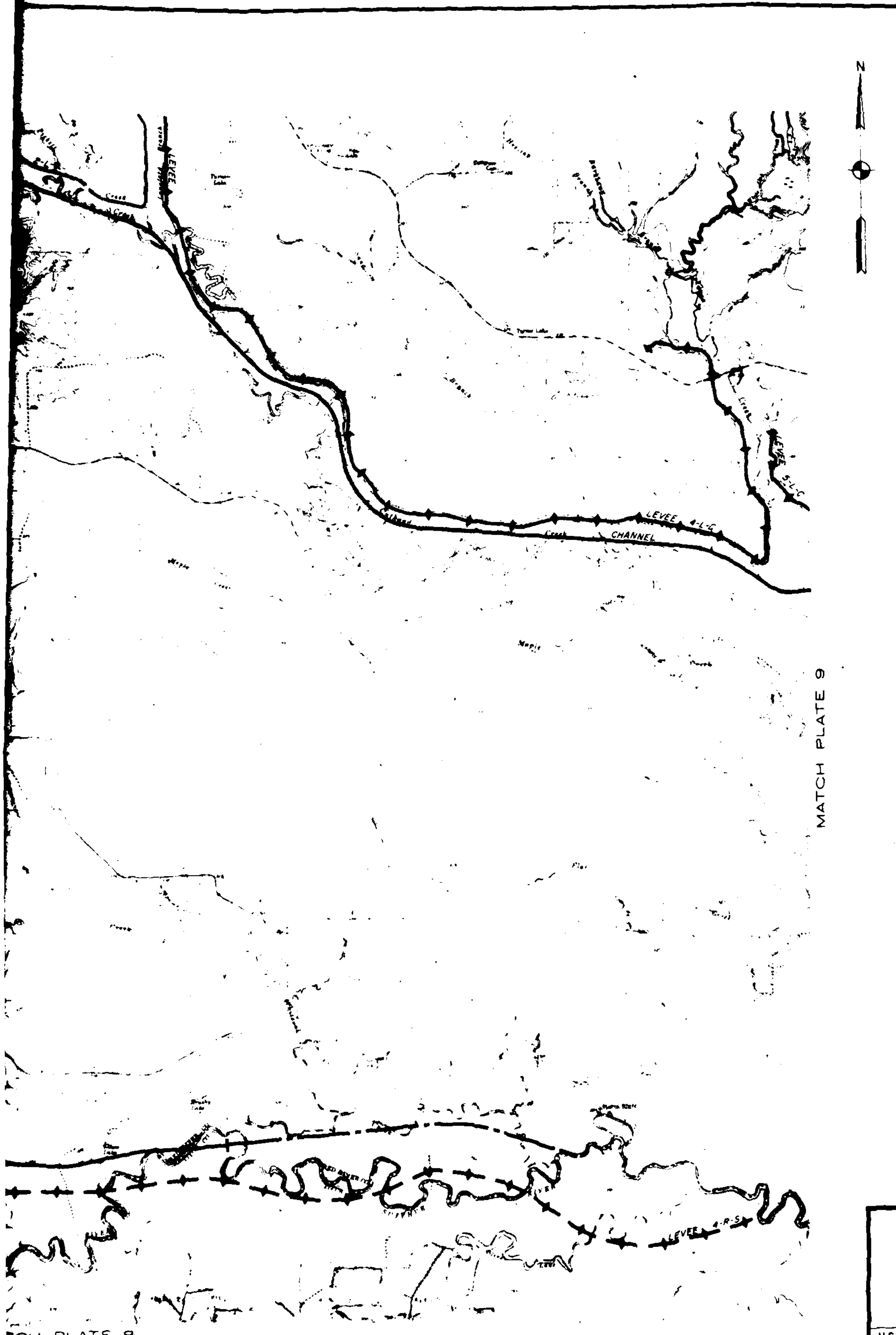
DATE

PLATE B-6

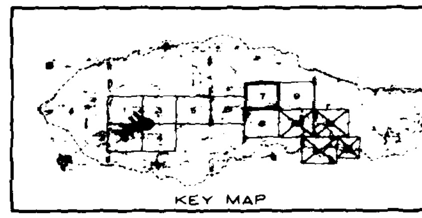
CORPS OF ENGINEERS



U.S. ARMY



VICINITY MAP



KEY MAP

LEGEND

LEVEES

EXISTING LEVEE

LEVEES (COOPER LAKE AND CHANNELS)

COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

NOT COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

CHANNELS (COOPER LAKE AND CHANNELS)

COMPLETED

PROPOSED

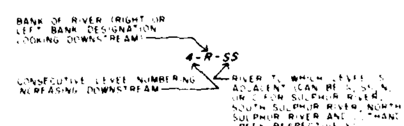
COOPER LAKE

WATER SUPPLY POOL EL 440.0

FLOOD CONTROL POOL EL 446.2

GOVERNMENT PROPERTY LINE

MITIGATION LANDS



SCALE OF FEET

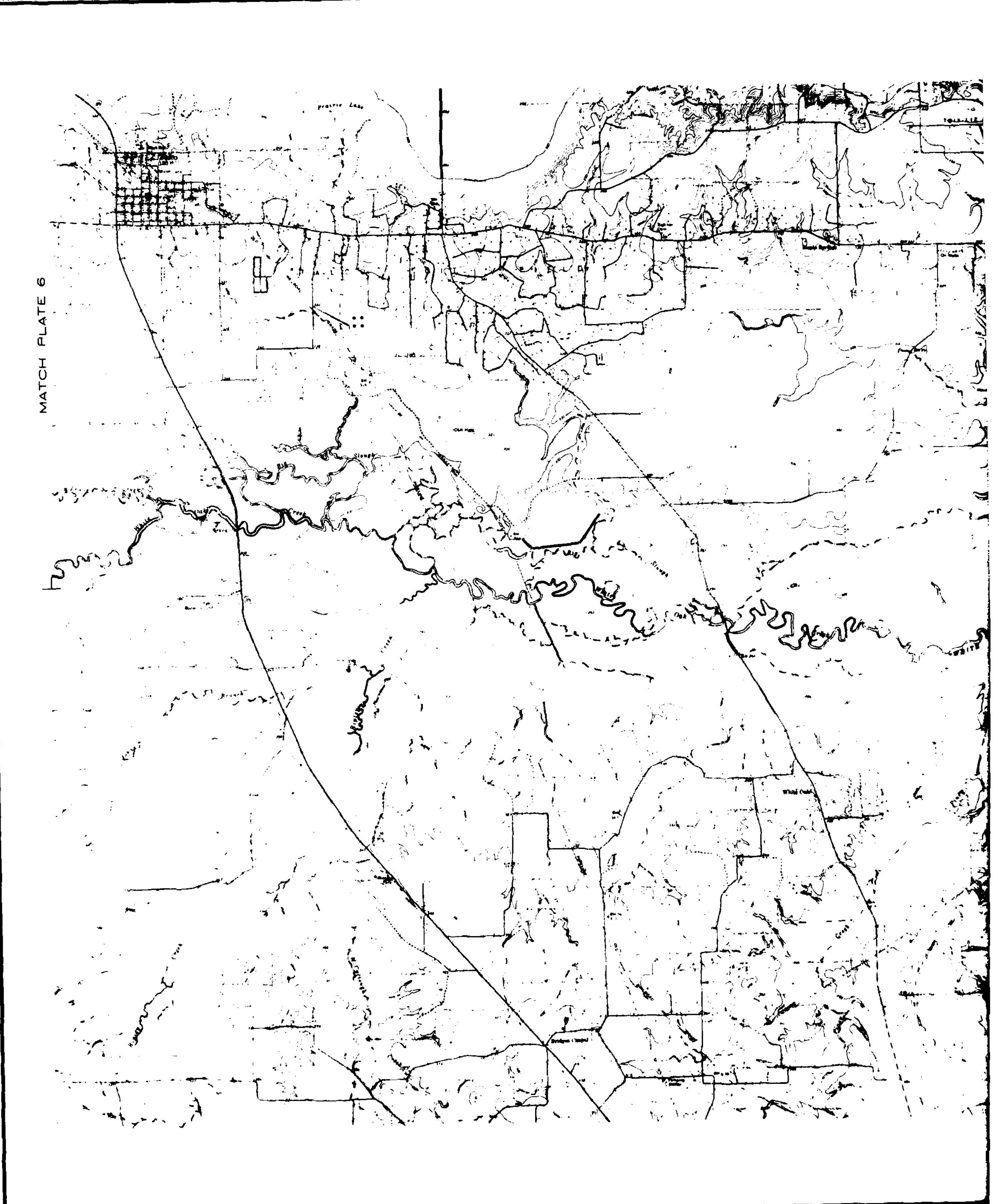
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

FEIS RECOMMENDED PLAN
(RESERVOIR AND LEVEES)

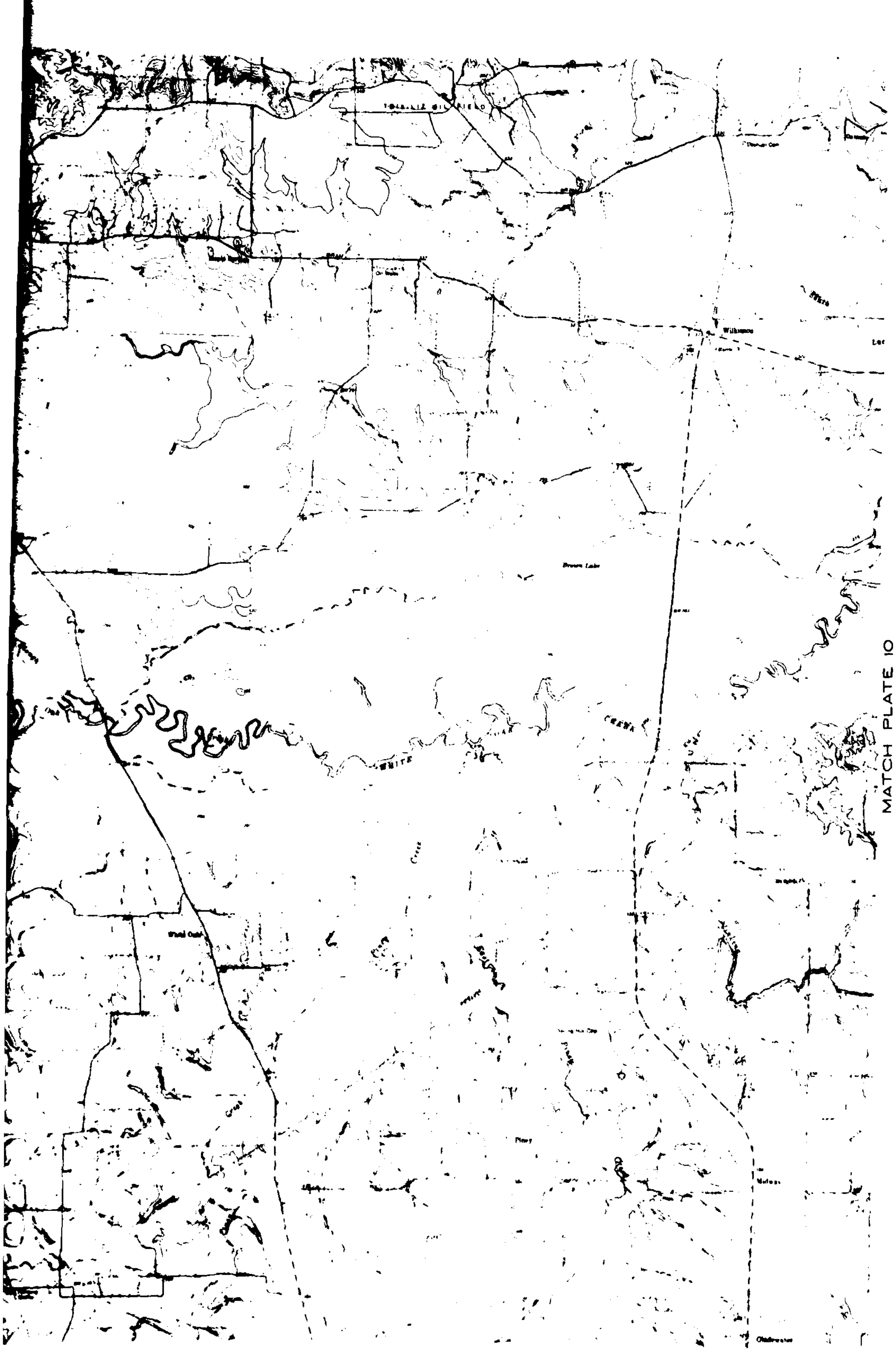
U S ARMY ENGINEER DISTRICT, FORT WORTH

DATE

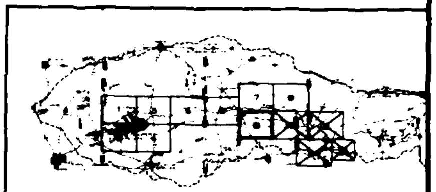
PLATE B-7


MATCH PLATE 6

U.S. ARMY



VICINITY MAP



KEY MAP

LEGEND

LEVEES

EXISTING LEVEE

LEVEES (COOPER LAKE AND CHANNELS)

COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

NOT COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

CHANNELS (COOPER LAKE AND CHANNELS)

COMPLETED

PROPOSED

COOPER LAKE

WATER SUPPLY POOL EL 440.0

FLOOD CONTROL POOL EL 446.2

GOVERNMENT PROPERTY LINE

MITIGATION LANDS

BANK OF RIVER (RIGHT OR LEFT BANK DESIGNATION LOOKING DOWNSTREAM)

4-R-SS

CONSECUTIVE LEVEE NUMBERING INCREASING DOWNSTREAM

RIVER TO WHICH LEVEE IS ADJACENT (CAN BE S, SS, N, OR C FOR SULPHUR RIVER, SOUTH SULPHUR RIVER, NORTH SULPHUR RIVER AND CUTHAND CREEK, RESPECTIVELY)

2000 0 2000 4000
SCALE OF FEET

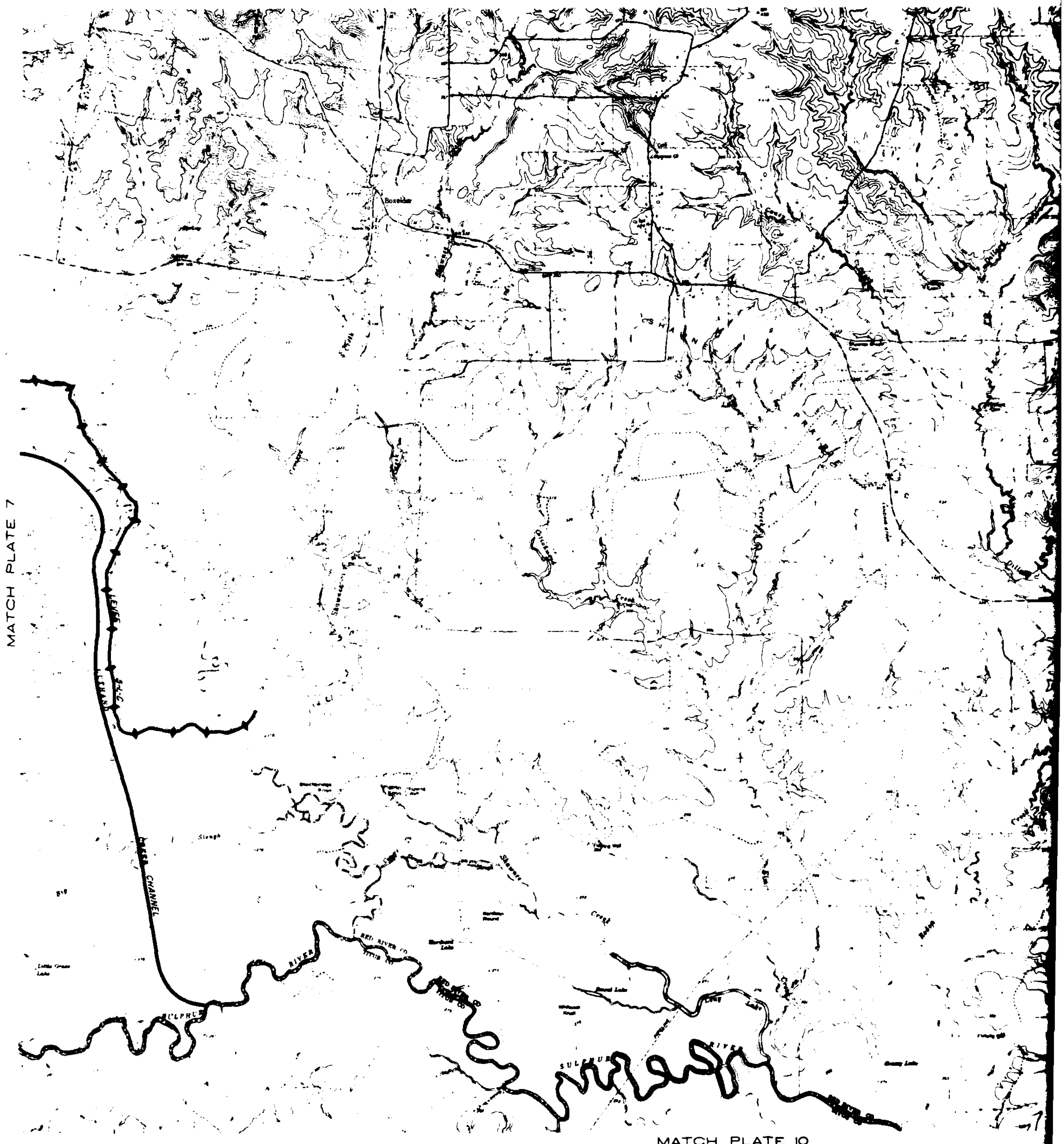
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

FEIS RECOMMENDED PLAN
(RESERVOIR AND LEVEES)

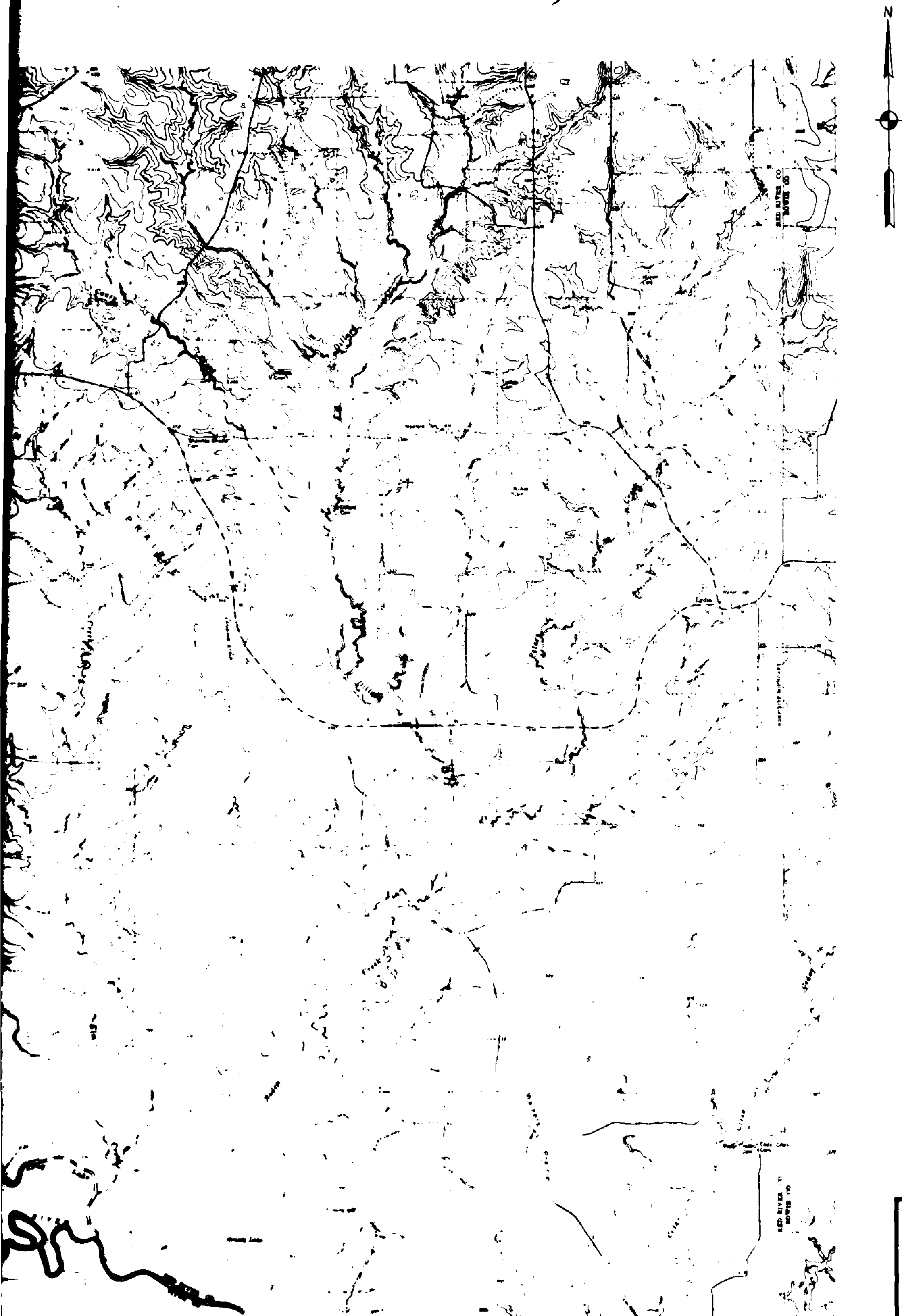
U.S. ARMY ENGINEER DISTRICT, FORT WORTH

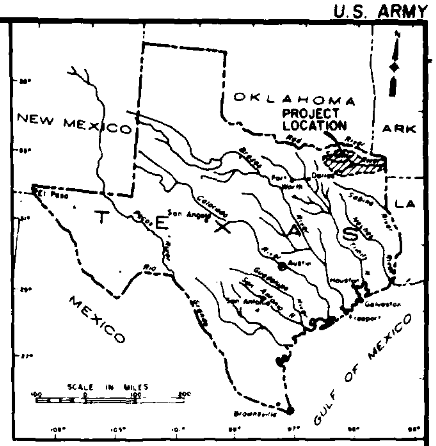
DATE

PLATE B-8

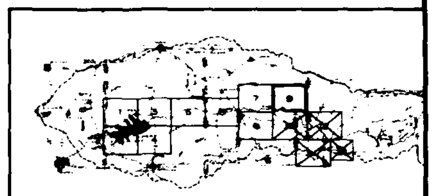

MATCH PLATE 7
Boxelder
CHANNEL
RIVER
Creek
MATCH PLATE 10

U.S. ARMY





VICINITY MAP



KEY MAP

LEGEND

LEVEES

EXISTING LEVEE

LEVEES (COOPER LAKE AND CHANNELS)

COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

NOT COMPLETED

ENLARGED EXISTING LEVEE

NEW LEVEE

CHANNELS (COOPER LAKE AND CHANNELS)

COMPLETED

PROPOSED

COOPER LAKE

WATER SUPPLY POOL EL 440.0

FLOOD CONTROL POOL EL 446.2

GOVERNMENT PROPERTY LINE

MITIGATION LANDS

BANK OF RIVER (RIGHT OR LEFT BANK DESIGNATION LOOKING DOWNSTREAM)

4-R-SS

CONSECUTIVE LEVEE NUMBERING INCREASING DOWNSTREAM

RIVER TO WHICH LEVEE IS ADJACENT (CAN BE S, SS, N, OR C FOR SULPHUR RIVER, SOUTH SULPHUR RIVER, NORTH SULPHUR RIVER AND CUTHAND CREEK, RESPECTIVELY)

2000 0 2000 4000
SCALE OF FEET

TCH PLATE 10

SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL ENVIRONMENTAL STATEMENT

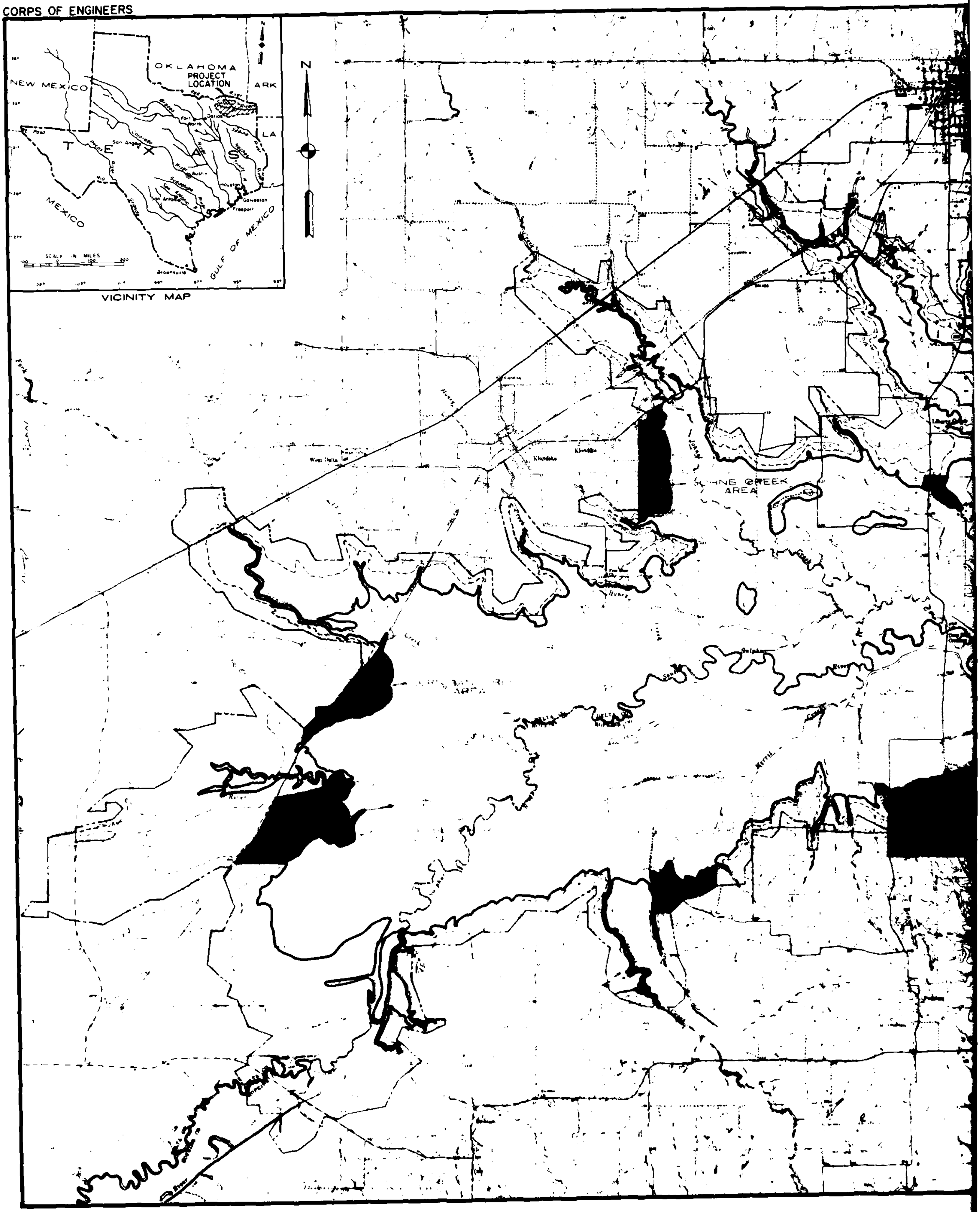
FEIS RECOMMENDED PLAN
(RESERVOIR AND LEVEES)

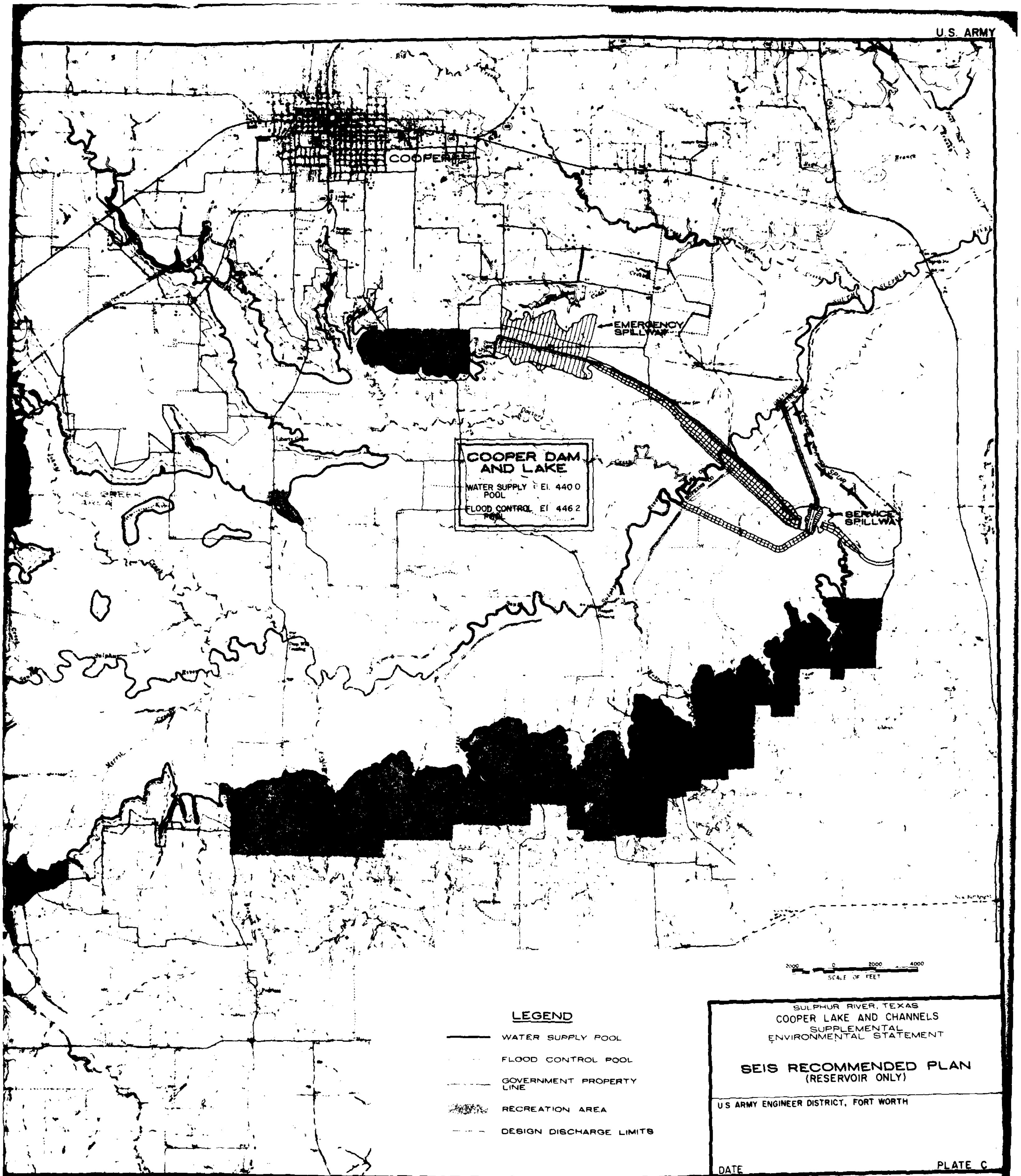
U S ARMY ENGINEER DISTRICT, FORT WORTH

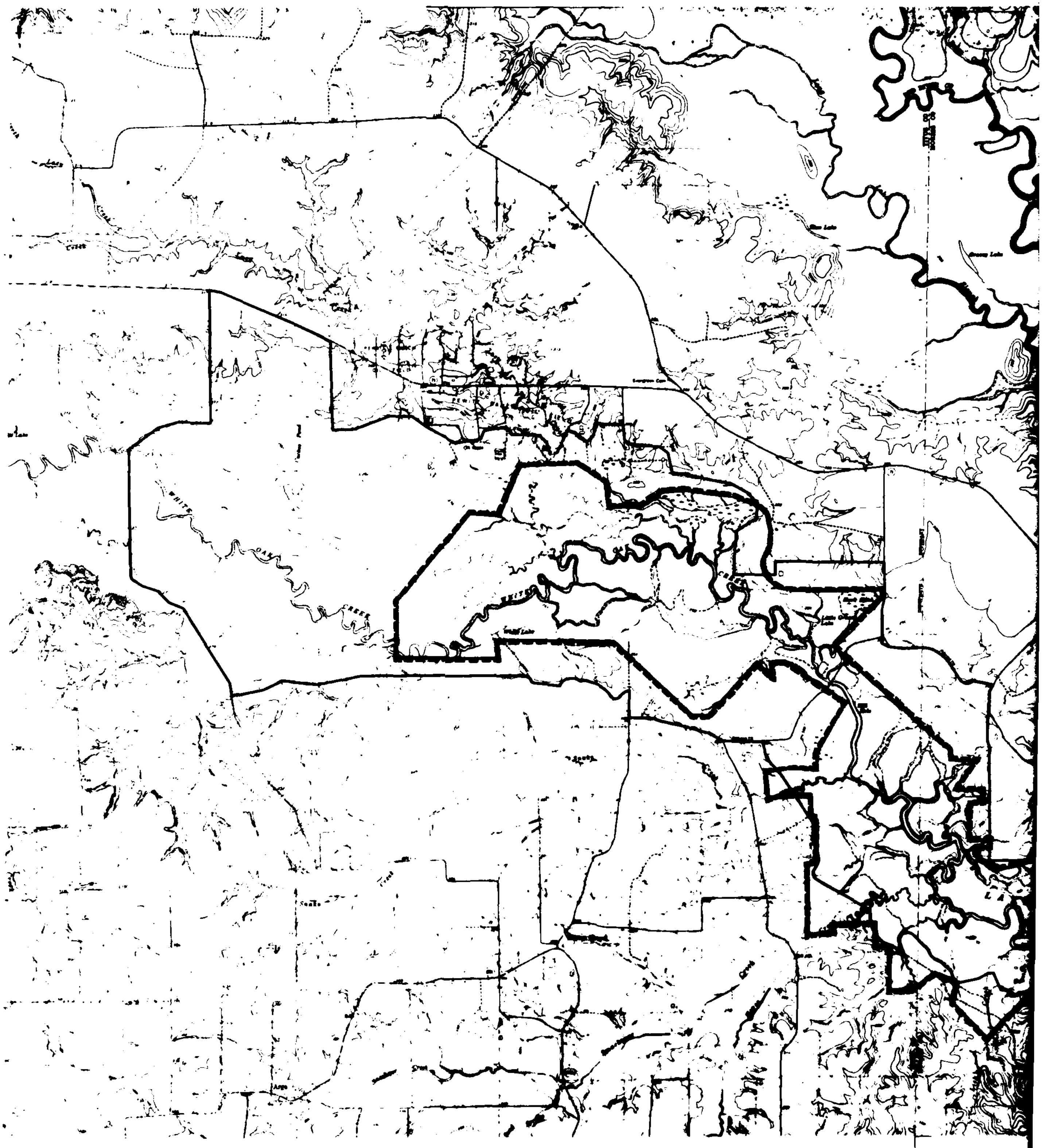
DATE

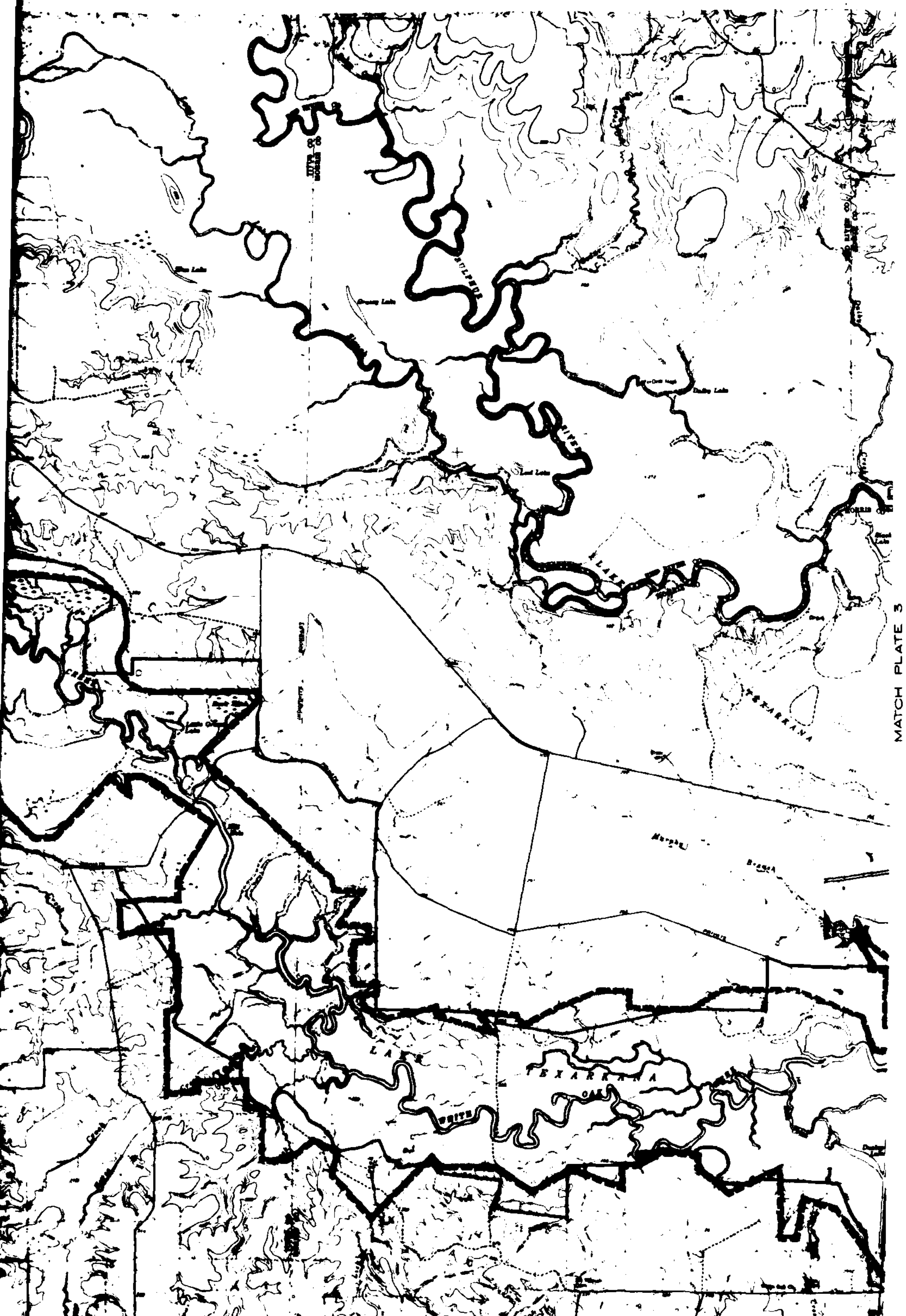
PLATE B-9

CORPS OF ENGINEERS



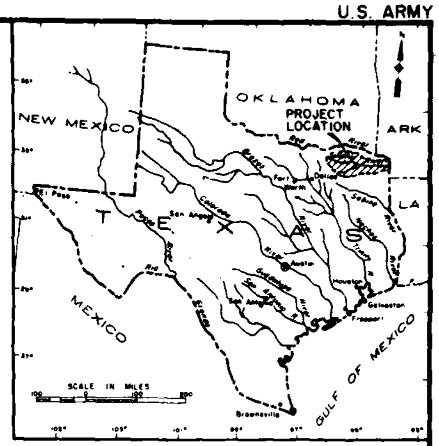

U.S. ARMY
COOPER
EMERGENCY SPILLWAY
COOPER DAM AND LAKE
WATER SUPPLY POOL EL 440.0
FLOOD CONTROL POOL EL 446.2
SERVICE SPILLWAY
2000 0 2000 4000
SCALE OF FEET
LEGEND
WATER SUPPLY POOL
FLOOD CONTROL POOL
GOVERNMENT PROPERTY LINE
RECREATION AREA
DESIGN DISCHARGE LIMITS
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL ENVIRONMENTAL STATEMENT
SEIS RECOMMENDED PLAN
(RESERVOIR ONLY)
U S ARMY ENGINEER DISTRICT, FORT WORTH
DATE
PLATE C



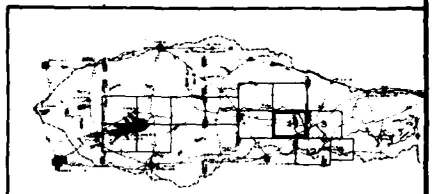


MATCH PLATE 3

MATCH PLATE 2



VICINITY MAP



KEY MAP

LEGEND

- USFWS COMPENSATION AREA
- FEE ACQUISITION LINE WRIGHT PATMAN LAKE
- FLOWAGE EASEMENT WRIGHT PATMAN LAKE
- CORPS RECOMMENDED MITIGATION AREA

2000 0 2000 4000
SCALE OF FEET

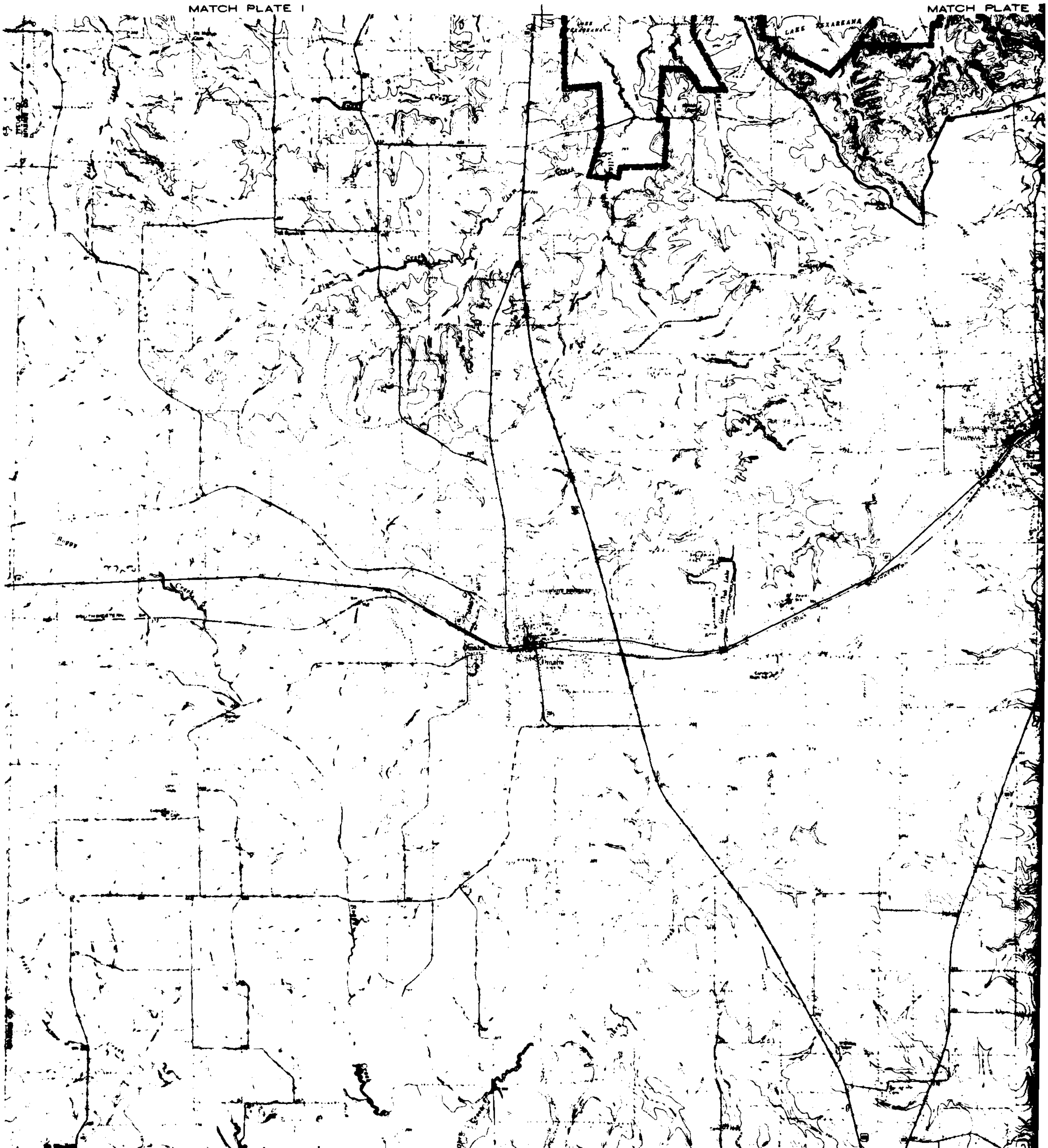
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

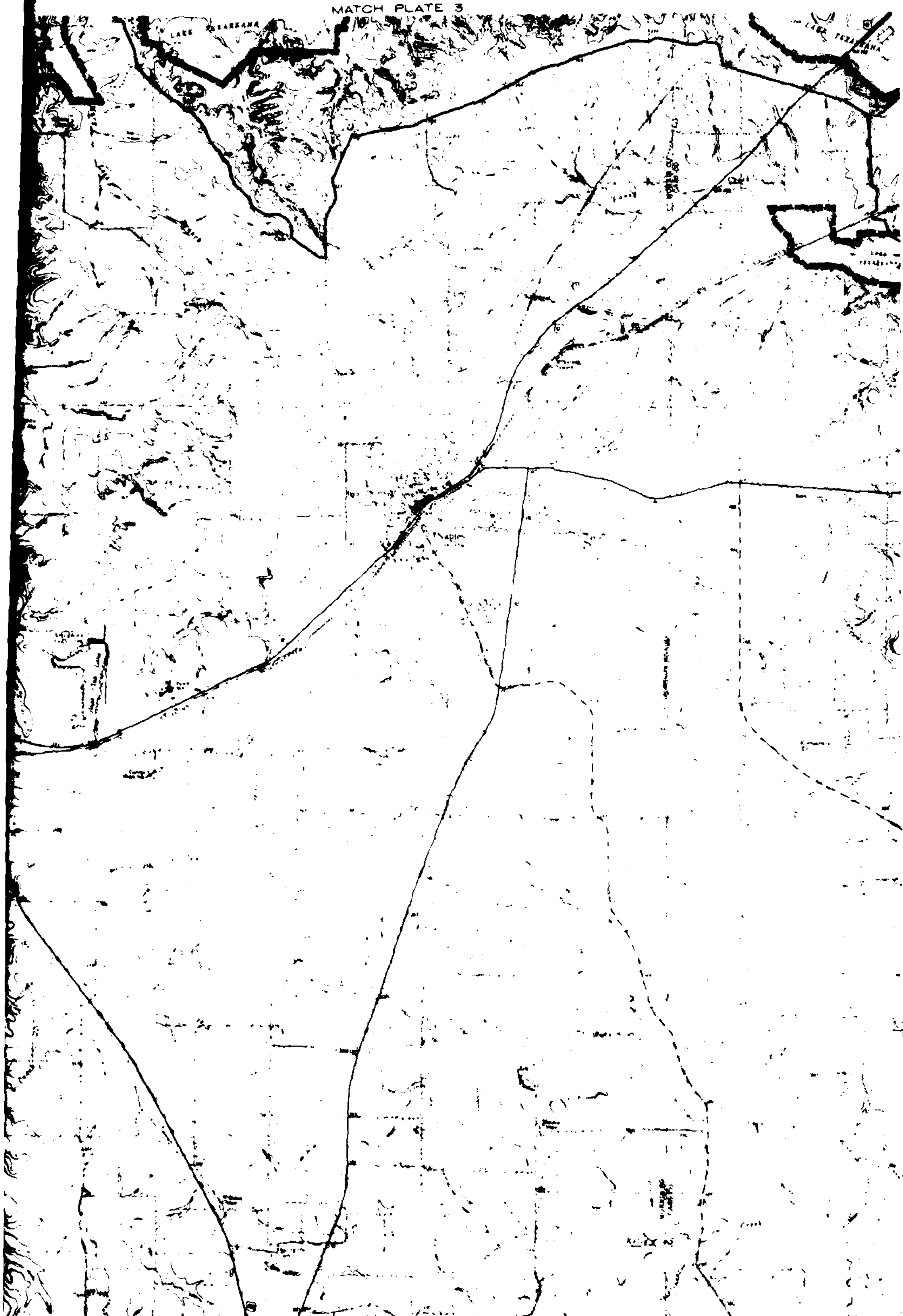
MITIGATION AREA FOR
SEIS RECOMMENDED PLAN

US ARMY ENGINEER DISTRICT, FORT WORTH

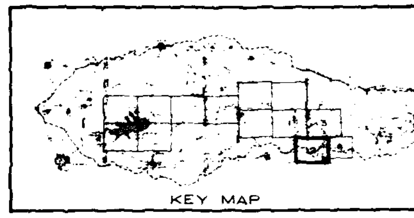
DATE

CORPS OF ENGINEERS





VICINITY MAP



KEY MAP

LEGEND

- USFWS COMPENSATION AREA
- FEE ACQUSITION LINE WRIGHT PATMAN LAKE
- FLOWAGE EASEMENT WRIGHT PATMAN LAKE
- CORPS RECOMMENDED MITIGATION AREA

SCALE IN FEET

SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

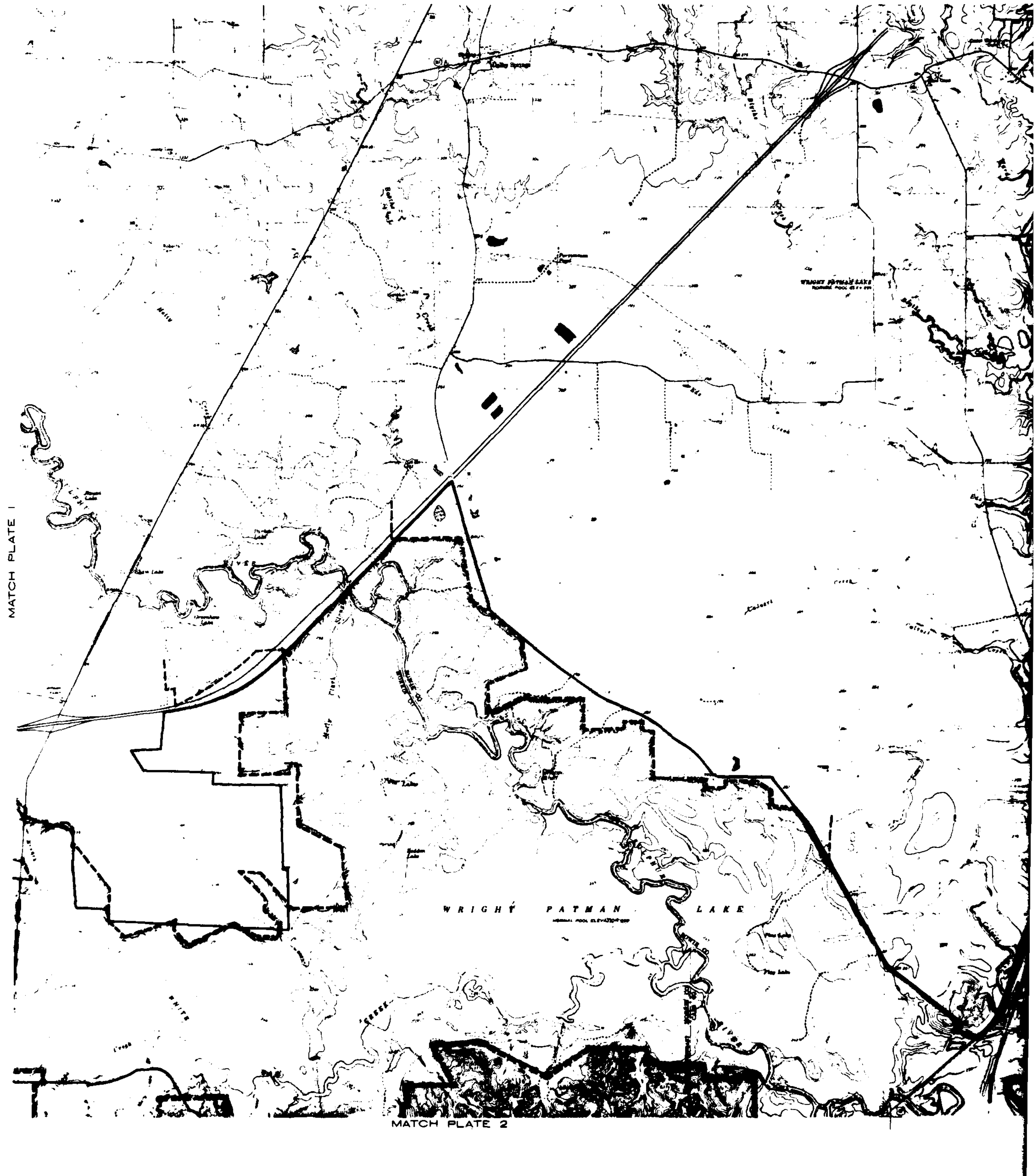
MITIGATION AREA FOR
SEIS RECOMMENDED PLAN

US ARMY ENGINEER DISTRICT, FORT WORTH

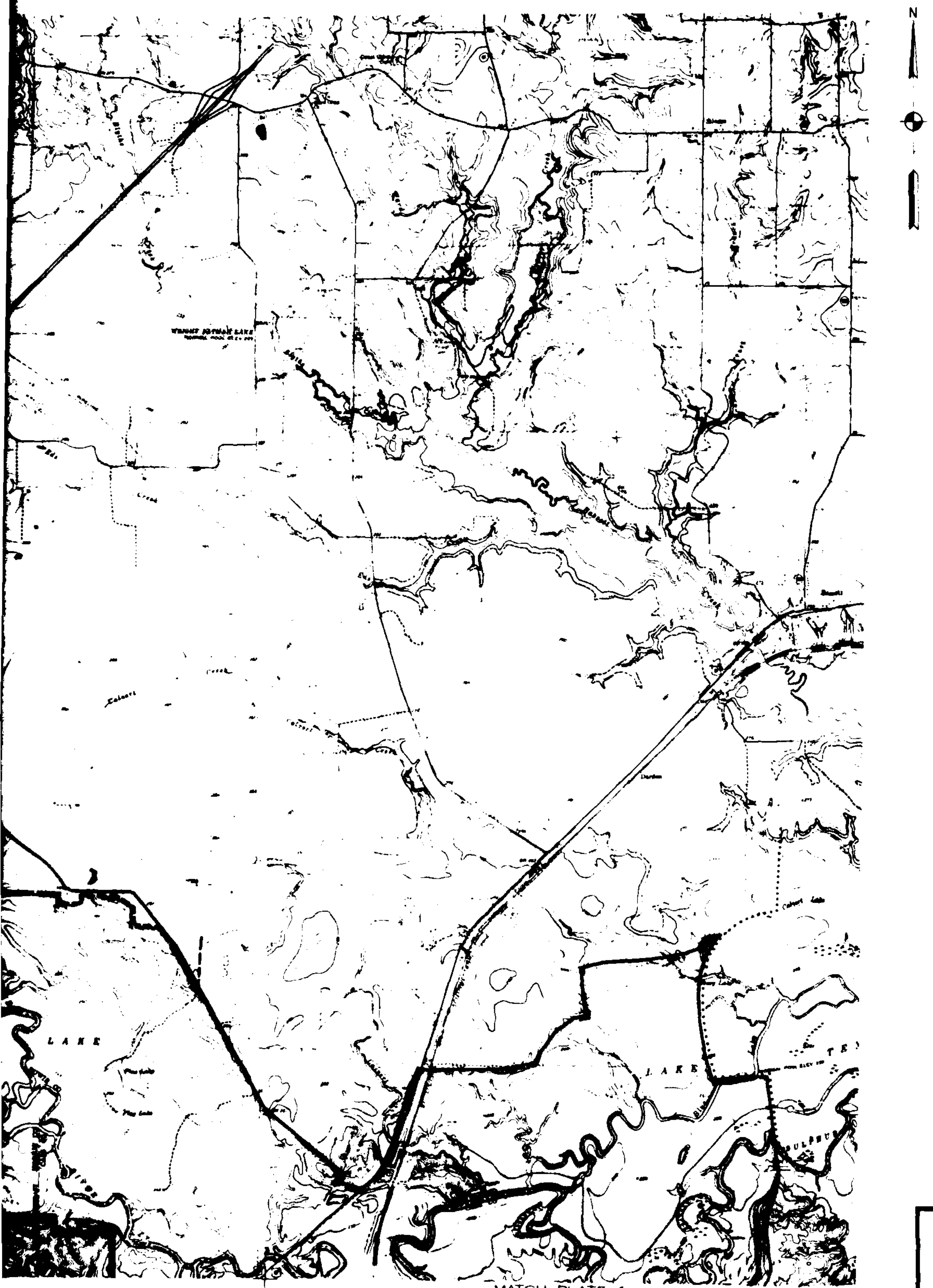
DATE

PLATE D-8

CORPS OF ENGINEERS

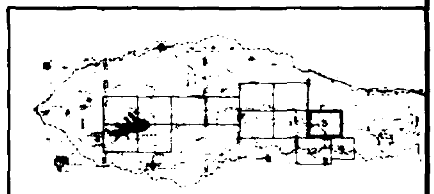


U.S. ARMY



MATCH PLATE 4

VICINITY MAP



KEY MAP

LEGEND

USFWS COMPENSATION AREA

FEE ACQUISITION LINE WRIGHT PATMAN LAKE

FLOWAGE EASEMENT WRIGHT PATMAN LAKE

CORPS RECOMMENDED MITIGATION AREA

SCALE OF FEET

SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL ENVIRONMENTAL STATEMENT

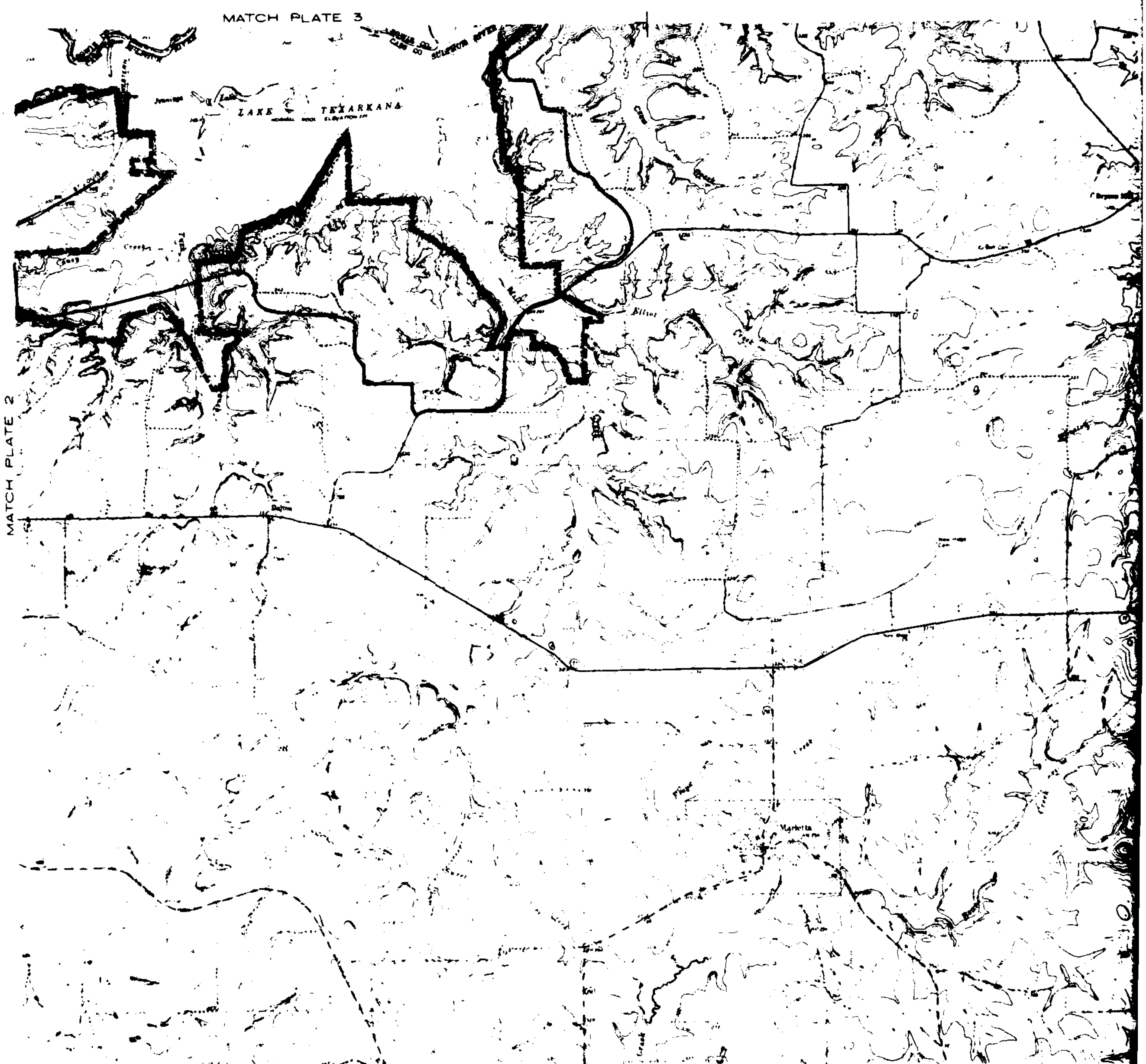
MITIGATION AREA FOR SEIS RECOMMENDED PLAN

U S ARMY ENGINEER DISTRICT, FORT WORTH

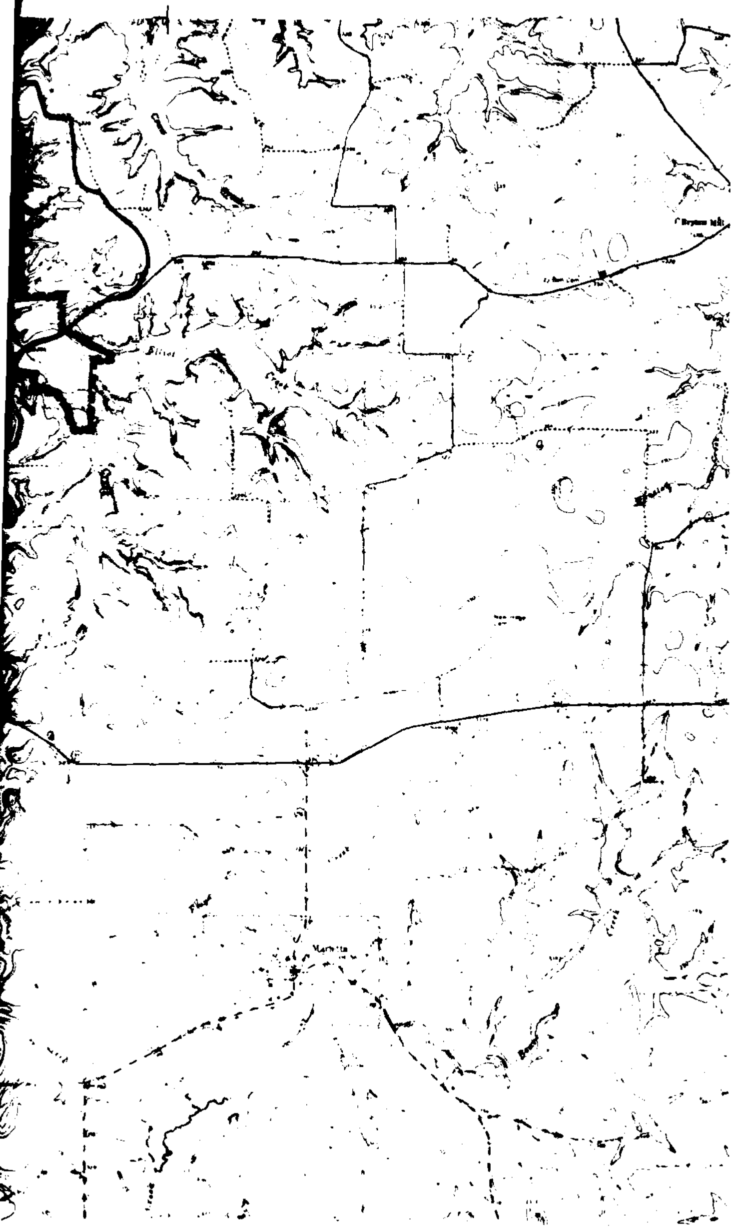
DATE

PLATE D-3

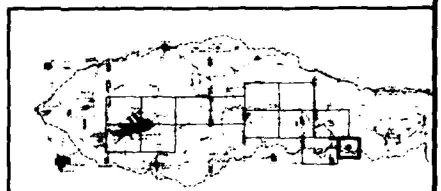
SINEERS



U.S. ARMY



VICINITY MAP



KEY MAP

LEGEND

USFWS COMPENSATION AREA

FEE ACQUISITION LINE WRIGHT PATMAN LAKE

FLOWAGE EASEMENT WRIGHT PATMAN LAKE

CORPS RECOMMENDED MITIGATION AREA

2000 0 2000 4000
SCALE OF FEET

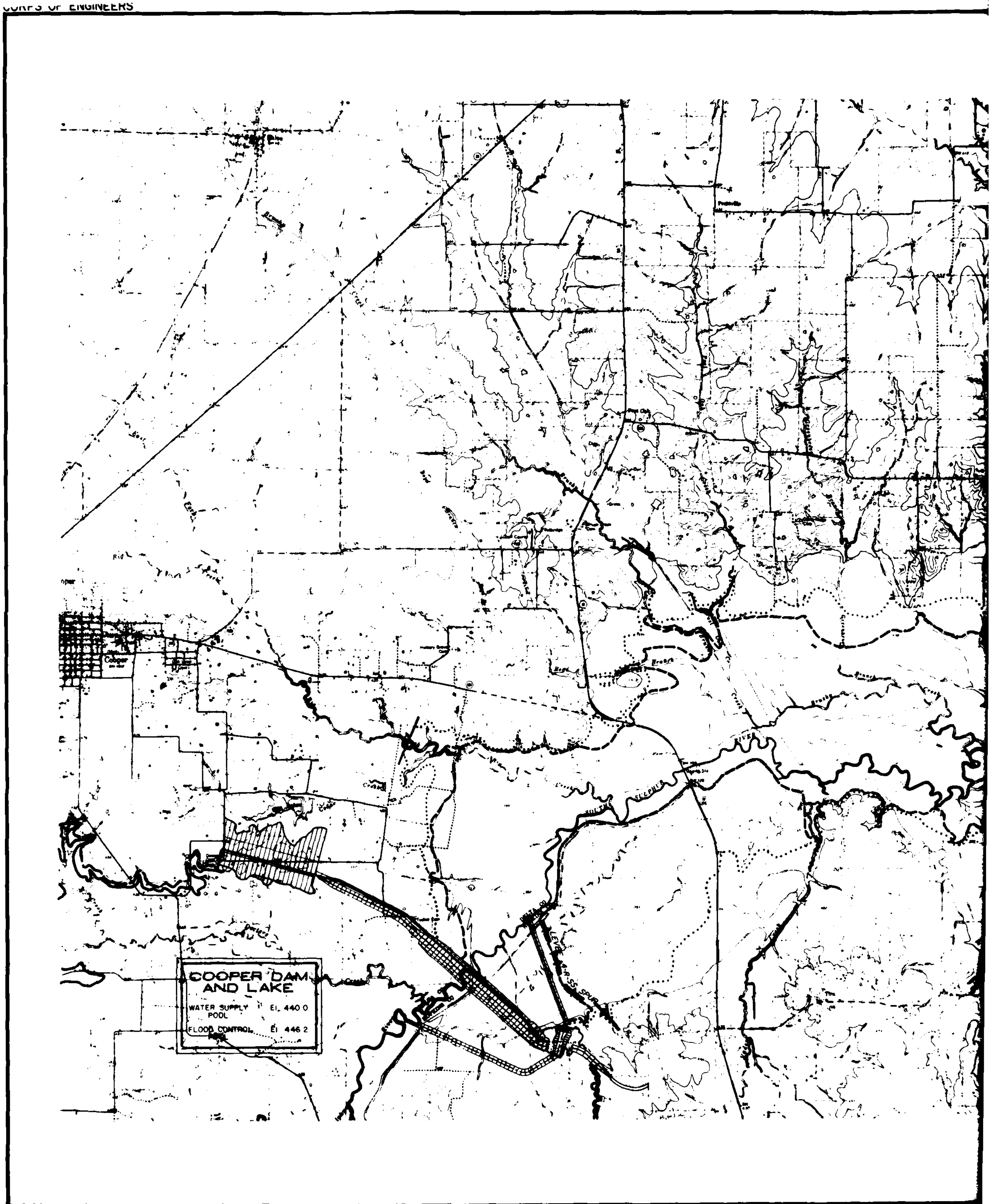
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

MITIGATION AREA FOR
SEIS RECOMMENDED PLAN

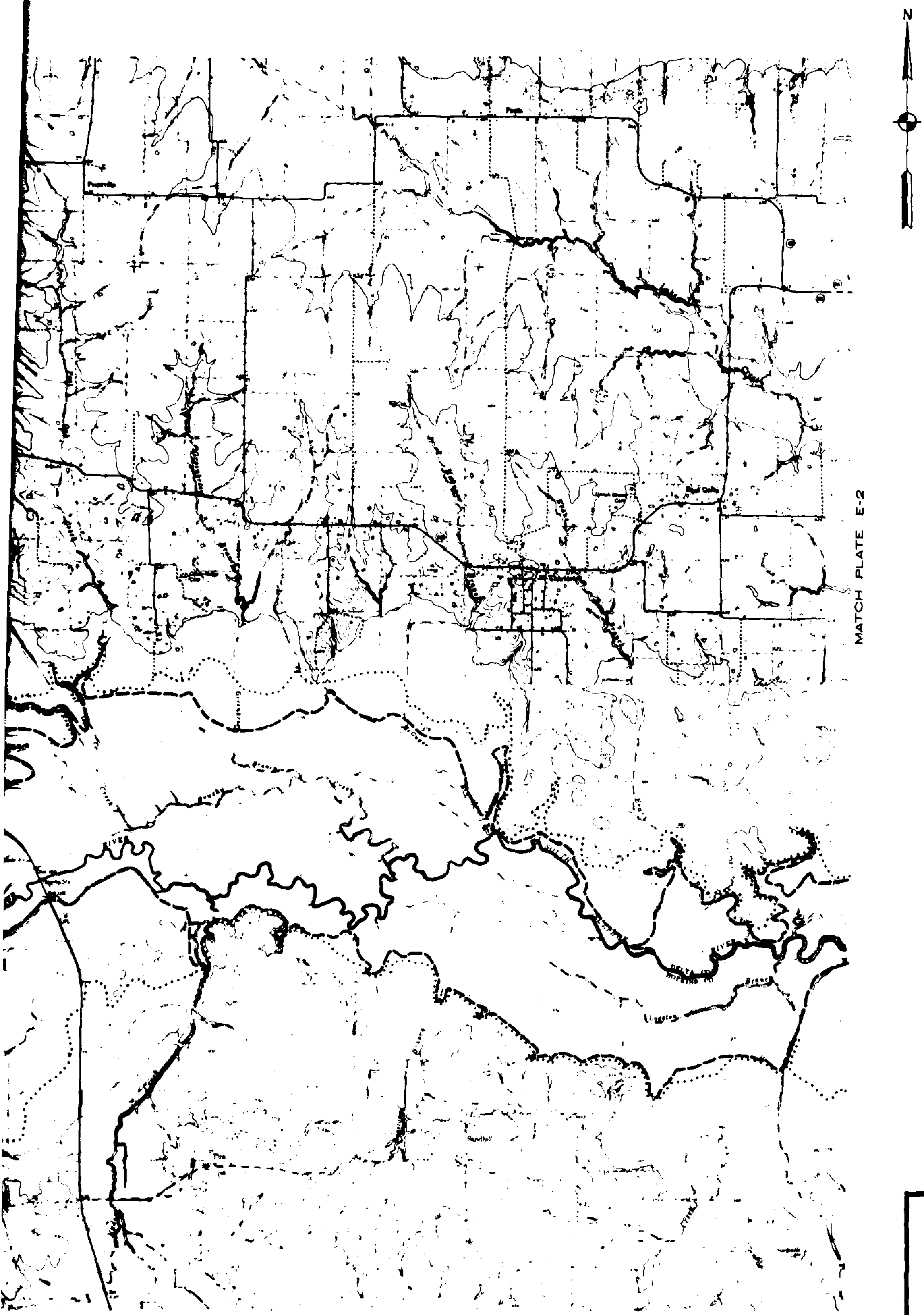
US ARMY ENGINEER DISTRICT, FORT WORTH

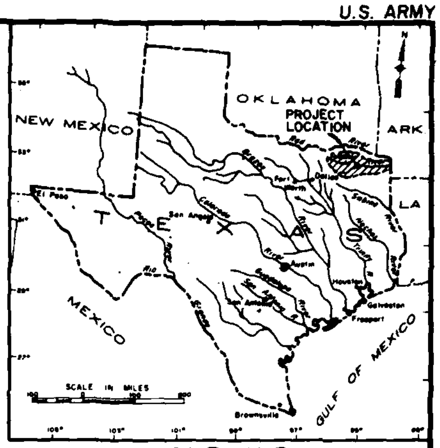
DATE

PLATE D-4

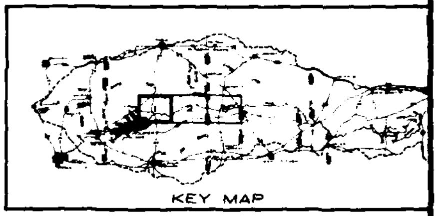

COOPER DAM AND LAKE
WATER SUPPLY POOL El. 440.0
FLOOD CONTROL POOL El. 446.2
Cooper

U.S. ARMY





VICINITY MAP



KEY MAP

LEGEND

- 30-YEAR EXISTING CONDITIONS
- 30-YEAR MODIFIED CONDITIONS
- WATER SUPPLY POOL
- FLOOD CONTROL POOL

2000 0 2000 4000
SCALE OF FEET

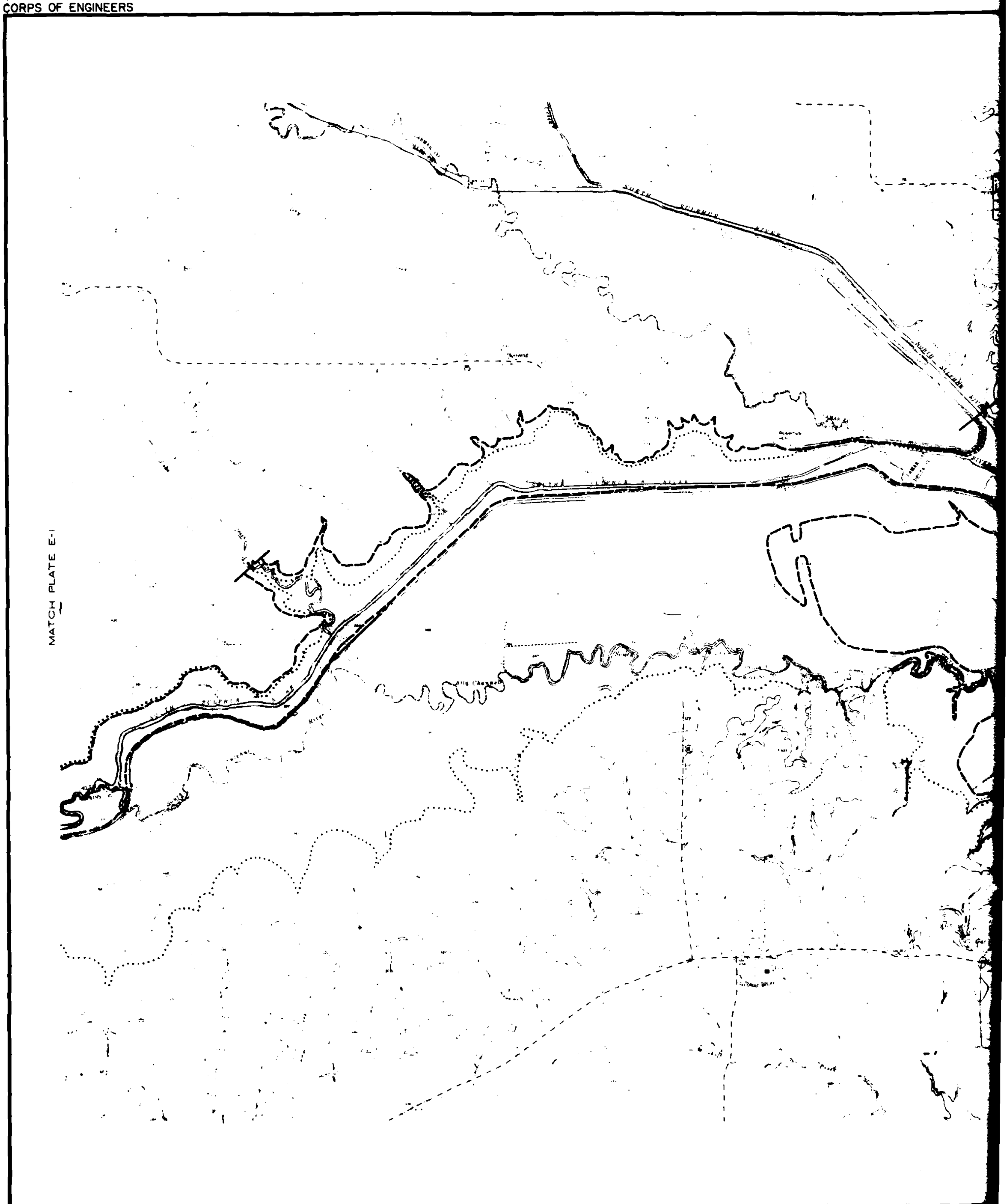
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

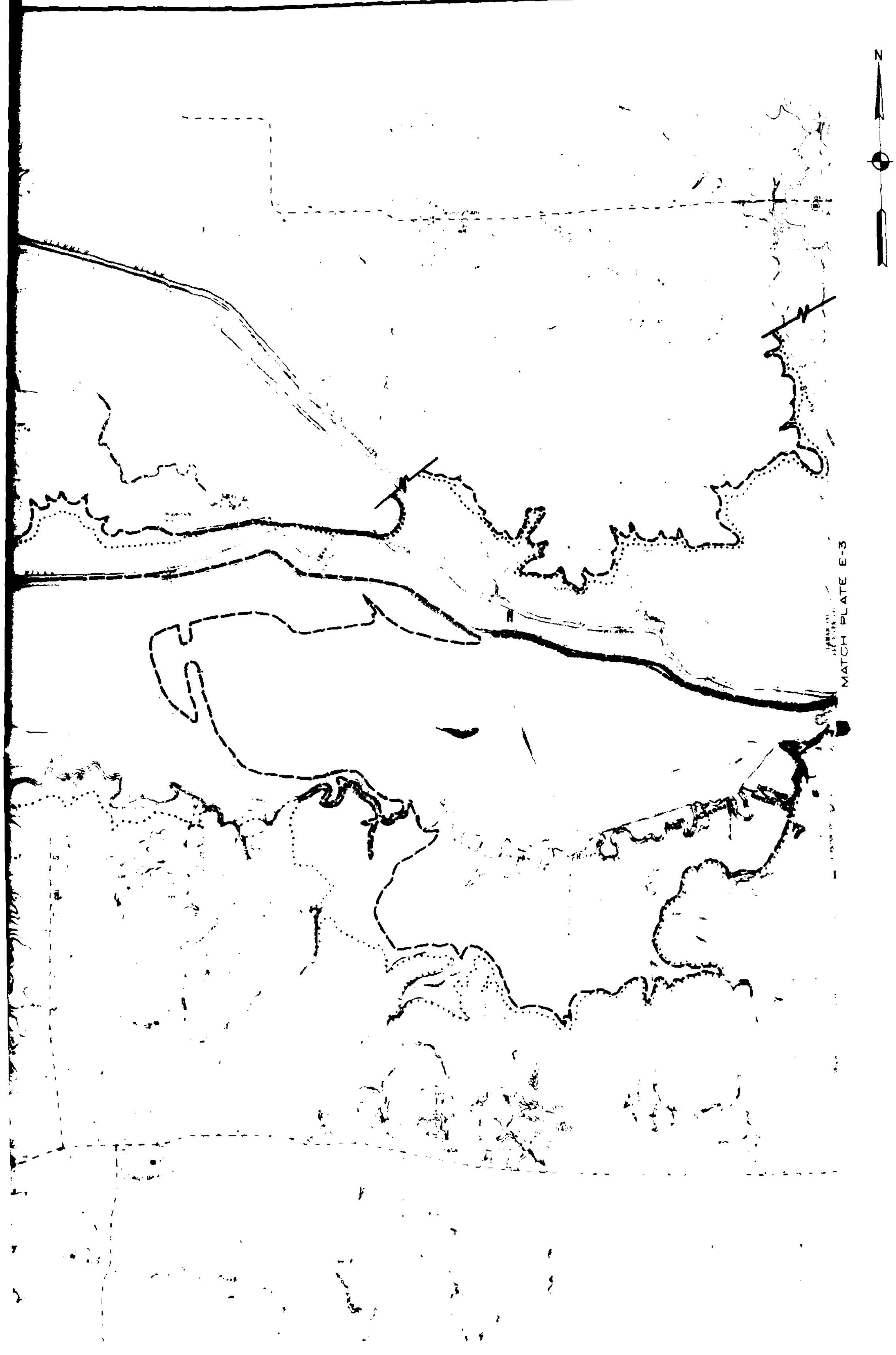
FLOODPLAIN MAP

U.S. ARMY ENGINEER DISTRICT, FORT WORTH

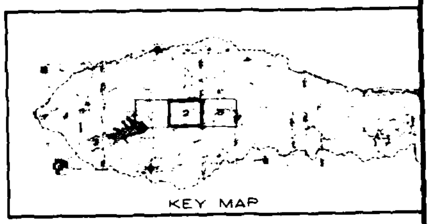
DATE

PLATE E-1


MATCH PLATE E-1



VICINITY MAP



KEY MAP

LEGEND

.... 30-YEAR EXISTING CONDITIONS

— — — — 30-YEAR MODIFIED CONDITIONS

SCALE IN FEET

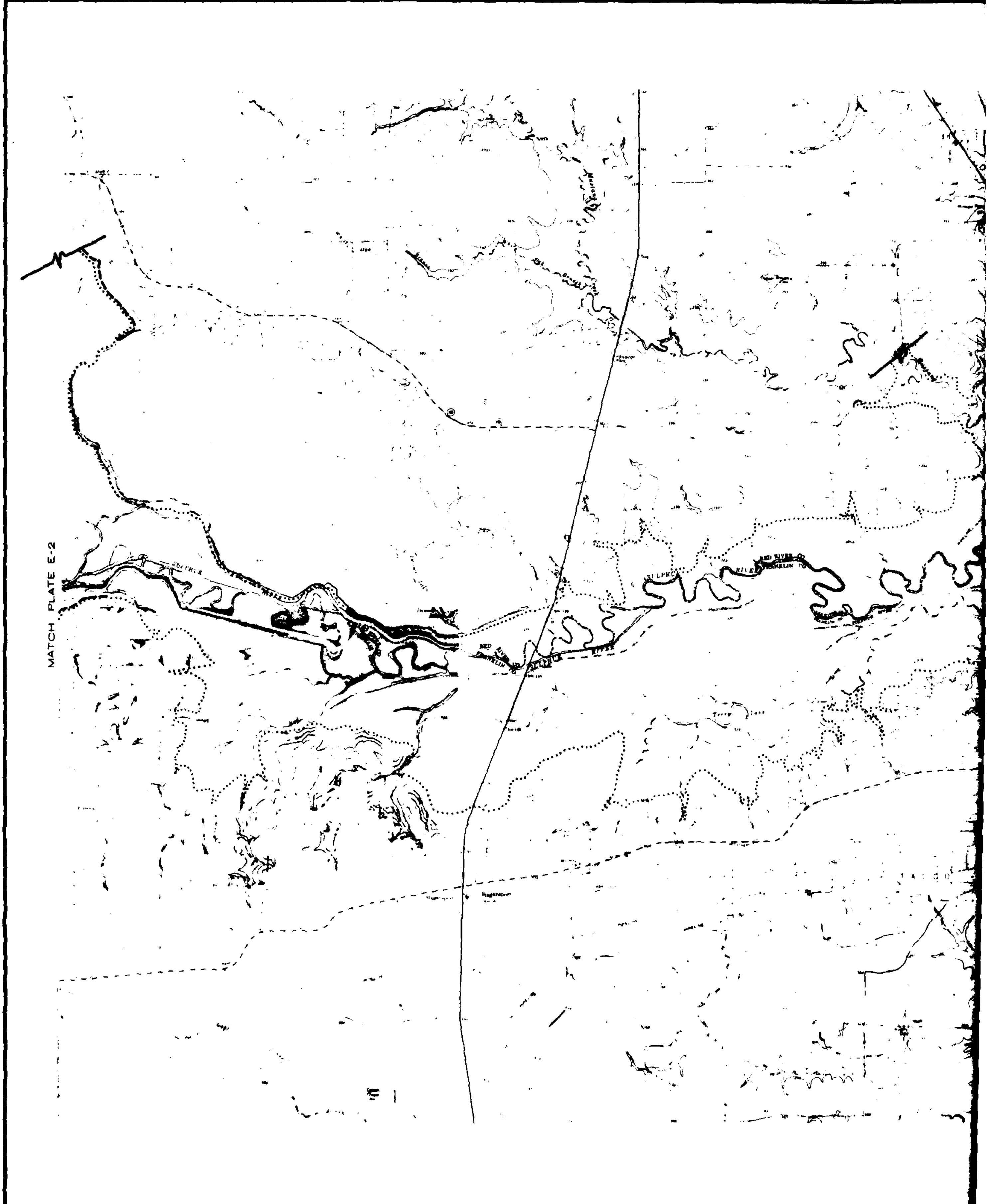
SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

FLOODPLAIN MAP

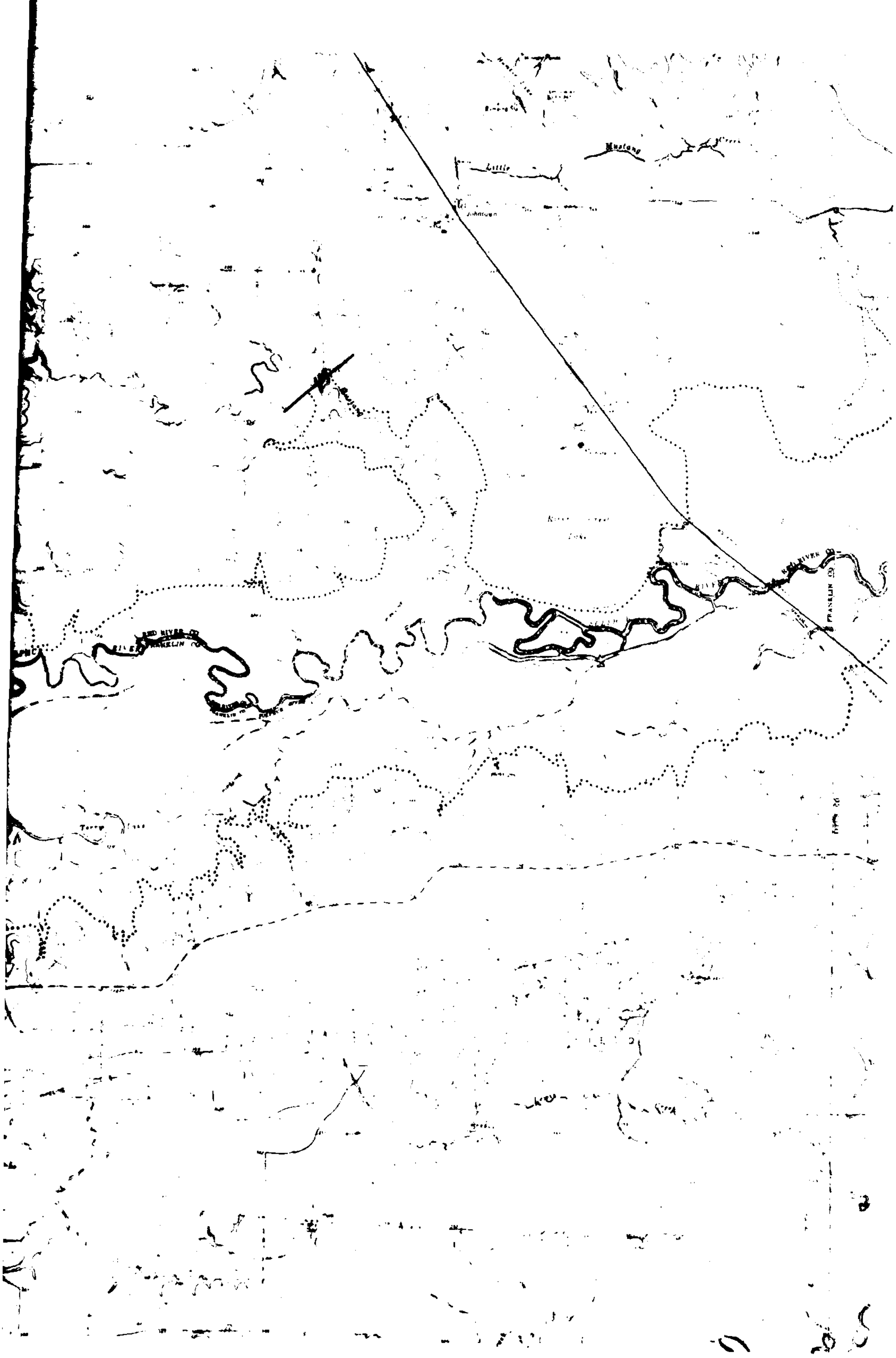
US ARMY ENGINEER DISTRICT, FORT WORTH

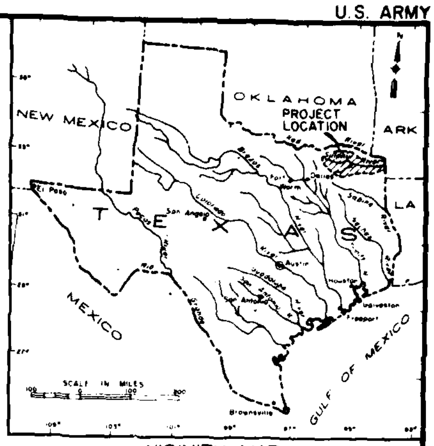
DATE

PLATE E-2

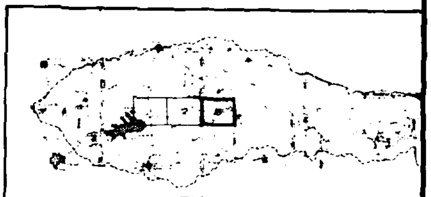

MATCH PLATE E-2
SULPHUR RIVER
RED RIVER CO
FRANKLIN CO

U.S. ARMY





VICINITY MAP



KEY MAP

LEGEND

30-YEAR EXISTING CONDITIONS

30-YEAR MODIFIED CONDITIONS

2000 0 2000 4000
SCALE OF FEET

SULPHUR RIVER, TEXAS
COOPER LAKE AND CHANNELS
SUPPLEMENTAL
ENVIRONMENTAL STATEMENT

FLOODPLAIN MAP

U.S. ARMY ENGINEER DISTRICT, FORT WORTH

DATE

PLATE E-3

DATE
ILMED

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